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FRIDAY, OCTOBER 21, 1898.

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CHEMISTRY AT THE JUBILEE MEETING OF THE AMERICAN ASSOCIATION.

THE union meeting of Section C of the American Association for the Advancement of Science and the American Chemical Society in Boston during the last week in August possibly approximated the desires expressed two years ago by the promoters of the joint session. The Jubilee meeting of the American Association dragged many who have not habitually attended the sessions from their seclusion. Those who did come, either for the first time or only after a lapse of years, observed an inspiring sight in the progress in the Association, and we are constrained to believe that Section C contributed its share to the success of the meeting.

Almost three hundred chemists attended the joint sessions. While Section C has been largely composed of members of the American Chemical Society, many more joined that Society, and numerous applications, in turn, were sent to the American Association. We are inclined to the opinion that did other of the affiliated societies but unite with the various sections in joint sessions only mutual good and benefit would result, as has been the case with Section C and the American Chemical Society.

Some 94 papers were presented before Section C and the American Chemical Society; 51 in full, 31 by abstract and 12 by title, representing the various branches

of chemistry. While there were many very interesting papers, perhaps the one that aroused most comment, favorable and conservative, was that of Dr. Chas. F. Brush 'On a New Gas in the Air—Etherion.'*

This gas, which is found absorbed by many substances, is a constituent of the atmosphere. Phosphorus pentoxide when cold absorbs it, but gives it up on heating. A year and a-half ago Dr. Brush, while looking for occluded hydrogen in glass, found not only that substance, but this new gas. The presence of the new gas made itself known by its enormous heat conductivity at low pressures. In a paper presented before Section B last year Mr. Brush gave the results of his experiments on the heat conductivity of various gases at low pressure. Hydrogen has been regarded the best gaseous conductor of heat. The occluded gas in powdered glass contained some hydrogen, but showed a greater heat conductivity. In repeated trials at purifying the gas by fractional diffusion, each time an increase of conductivity was observed until a gas was obtained with a heat conductivity one hundred times that of hydrogen. The experiments were not reported as continued to a point when the conductivity was the same before and after diffusion, so the impurity of the substance was readily acknowledged.

A table of figures was exhibited, showing the molecular weight, density, specific heat, relative mean molecular velocity and heat conductivity of the gases, whose heat-conducting curves appeared in a chart; and attention was directed to the evident close relationship between heat conductivity and molecular velocity of the gases.

From this relationship some other properties of the new gas were deduced. Taking the heat conductivity of the new gas at a hundred times that of hydrogen—a very conservative estimate—its mean molecular velocity at freezing temperature was calculated to be more than a hundred miles per second, and its density only a thousandth part that of hydrogen; while the specific heat was found to be six thousand times greater than that of hydrogen, this substance having the greatest specific heat heretofore known. These figures were adduced simply to show the order of magnitude that may be established by further investigation.

It was shown that a gas having properties anything like those cited could not possibly be confined to the earth's atmosphere, and hence the new gas, being found here probably extends indefinitely into space and constitutes an interstellar atmosphere, whence its name. The possibility that *etherion* may be found to be identical with the so-called ether was touched upon, and Dr. Brush expressed the hope that it would be found to account for at least some of the phenomena heretofore attributed to the ether. No spectroscopic data were presented.

Dr. Edgar F. Smith's vice-presidential address on 'An Electric Current in Organic Chemistry' was a clear-cut history, first, of the application of electricity to chemistry in general, then to organic bodies in particular. The difficulties in investigating changes in organic substances wrought by the electric current are great, for no single line of reaction seems to be followed invariably and numerous by-products are formed. As this valuable contribution to the history of Electro-chemistry offered by a pioneer in and authority on the subject has been published in Science, no further reference will be made to it in this *résumé* of the Proceedings of Section C.

All the papers presented at the joint sessions were provisionally divided into the following subdivisions: Inorganic, Organic, Analytical, Technical, Physical, Physio-

* This paper was printed in the last number (page 485) of Science.—Ed. Science.

logical, Agricultural and the Teaching of Chemistry. Below is given a full list of the titles, but space will not permit abstracts of all the papers presented.

Dr. C. L. Reese exhibited some unusual quartz crystals from Alabama, containing petroleum inclusions.

A paper 'On the Facilities for Standardizing Chemical Apparatus afforded by Foreign Governments and Our Own,' read by Mr. L. A. Fisher for Mr. H. S. Pritchett, called attention to the work begun by the Coast and Geodetic Survey of the United States. In comparison with Germany and France few facilities are now offered by our government, practically none were in the past, so this is an important forward step.

Mr. N. Monroe Hopkins showed drawings of a new Electric Furnace for a 110-Volt Current of High Efficiency. It is easy of construction and inexpensive.

'Catalysis,' Dr. J. H. Kastle. Assumptions regarding catalytic processes from work on sulphonic esters involving the quadrivalence of oxygen were given. Brühl, in his work on hydrogen dioxide, prefers to regard water as containing oxygen unsaturated.

'Volumetric Apparatus,' G. E. Barton.

'Some New Forms of Apparatus,' J. M. Pickel.

'A New Apparatus for Determining the Relative Viscosity of Thick Oils and Softness of Plastic Matter,' A. W. Dow.

'Viscosimeter,' P. H. Conradsen.

Dr. F. W. Clarke called attention to the solubility of certain natural silicates in distilled water, in his paper on 'The Alkaline Reaction of Certain Natural Silicates.' The alkaline reaction is given very quickly by some and more slowly by others. This is an interesting point for geologists.

Dr. C. Loring Jackon, with I. H. Derby, gave the properties of pure, freshly prepared 'Ferrous Iodide.'

One of the most interesting sessions was that set aside for the discussion of the methods of teaching chemistry. Many outsiders were attracted by this part of the program. Dr. F. P. Venable, who had the leading paper, spoke 'On the Use and Abuse of the Formula in Teaching Chemistry.' Dalton seems to have been the first to use a regular system of symbols in making clear his idea of atoms. Berzelius then took up the practice, which gives us a universal but short-hand language in chemistry. While there is no question of the value of formulas and equations in teaching chemistry, some of the limitations of their use should be recognized. Symbols and equations can only partially represent the mathematical relations of the science, for there is no mode of indicating the physical forces always accompanying chemical reactions. Frequently the best constructed equation represents only one of the many reactions occurring at the same time, and there is no way to indicate conditions, relation of mass and so on. While useful, the dangers may be classified under four heads: methodism, mechanical, mathematical and idolatry.

Dr. Ira Remsen, in his paper on 'Teaching Organic Chemistry,' deprecated 'formula worship' and insisted upon having the thing talked about actually before the student and allowing him not only to see but handle the substance as much as possible. In laboratory work it is more essential to have the student familiarize himself with a few simple compounds first until a basis is established, avoiding the mechanical and acquiring the true spirit and right idea. Many teachers make the mistake of talking over the heads of students. This serves well to exhibit the professor's own mental adroitness, but does not aid the pupil much.

Dr. Hart, when speaking on 'The Teaching of Industrial Chemistry,' insisted that industrial application of what had been learned was the crowning point of all teaching of chemistry. He held the idea that only a

few of the many laboratory students are fit for manufacturing chemists, whose preliminary training should be of the highest order, especially in mathematics. The student should have a wide experience in chemical preparations and be able to purify quickly and study them on a large scale. After such training a man should be sent into a factory for at least two years as a student. Our hope lies in the fundamental training in good technical schools.

Dr. W. L. Dudley asserted, in presenting his remarks upon 'Teaching Analytical Chemistry,' that a good course in experimental work should precede qualitative analysis. If only a little time is available it should be devoted to experimental and not to qualitative analysis, for fear of turning out men who with only a smattering would think themselves real chemists. He did not believe in books for special students, but in true qualitative analysis containing thoroughly accurate methods for the common metals and semi-common ones. He insisted upon the absolute necessity for accuracy and that the course should be comprised of such methods and not of shorter ones that are inaccurate. In quantitative analysis it is better to teach manipulation and principles and not all the methods of analysis known.

In a paper by Dr. H. W. Wiley, read by Dr. E. E. Ewell, on 'The Influence of Temperature upon the Specific Rotary Power of Sucrose,' it was brought out that, contrary to the generally received ideas, there is a marked influence produced by change of temperature, the specific rotary power lowering as the temperature rises.

Three papers were presented by Drs. W. A. Noyes, Hillebrand and N. W. Lord upon coal analysis. The correct determination of water in a coal seems to be obtained only by drying the sample over sulphuric acid in a vacuum dessicator. This is a long method and scarcely applicable in technical work. This was a partial report of the Committee on Coal Analysis.

'The Determination of Water and Coke in Coal,' W. A. Noyes and N. M. Austin.

'Notes on Determination of Water in Coal,' W. E. Hillebrand.

'The Valuation of Coals,' N. W. Lord.

'Analysis of Mixed Acids,' Chas. E. Munroe.

'A Simple Color Reaction for the Detection of Methyl Alcohol,' S. P. Mulliken and Heyward Scudder.

'Detection of Nitro Group in Organic Compounds,' S. P. Mulliken and E. R. Barker.

'Electrolytic Determination of Tin in Tin Ores,' E. D. Campbell and E. C. Champion. This depends upon fusing the ore with sodium carbonate and sulphur, conversion of the sulpho-stannate into sulphide, then into double ammonium oxalate and electrolyzing.

'The Determination of Undigested Fat and Casein in Infant Feces,' Herman Poole.

'New Method for the Determination of Zinc,' A. C. Langmuir.

'Note on the Determination of Arsenic in Glycerine,' A. C. Langmuir.

Professor H. L. Wells, in his 'History of Double Salts,' stated that the laws governing this class of compounds seem very intricate. The chlorides do not seem to correspond to the bromides, and iodides, and halides of closely related metals often differ.

Dr. J. L. Howe and E. A. O'Neal stated, in their paper on the 'Use of the Electric Current in Forming Alums,' that they had prepared alums containing the metals aluminum, iron, cobalt, rubidium and cesium, by means of an electric current, but failed to get them of manganese and ruthenium. These compounds of rubidium and cesium are next. Dr. Howe, with S. G. Hamner, gave a method for accurately determining 'The Color of Sulphur in the

Gaseous State.' This is variously given in the different text-books.

Professsr O. C. Johnson gave 'A New Test for Nickel,' which consists of the treatment of the washed precipitates of nickelic and cobaltic oxides with potassium iodide. The presence of nickel is indicated by the liberation of iodine.

Dr. J. H. Kastle reported 'On the Occurrence of Barium and Strontium' in a large number of Kentucky and Ohio limestones. He drew out the point that where one metal of a triad is present in large quantities the other members of the series are invariably also present.

'The Estimation of Iron and Aluminum in Natural Phosphates,' H. W. Wiley and F. P. Veitch.

'A Study of the Tellurides,' Cabell Whitehead.

'Magnetic Ferric Oxide,' W. L. Dudley.

'The Action of Various Bases on Metallic Arsenites,' C. Wellington.

'The Action of Chromic Acid on Hydrogen,' C. L. Reese.

'The Action of Soft Waters on Metals,' Ellen H. Richards and Willis R. Whitney.

'A New Method of Standardizing Hydrochloric Acid,' F. K. Cameron and J. A. Emery.

Dr. C. Loring Jackson, in his paper entitled 'Certain Peculiar Reactions of the Tribromnitrophenols,' gave an account of his work on the action of sodium malonic ester, sodium acetoacetic ester and sodium ethylate on tribromnitrophenols and related substances with a view to determining why the bromine is replaced by hydrogen. Dr. A. B. Prescott's paper, 'On Certain Alkaloidal Periodides and the Volumetric Estimation of Alkaloids as Higher Periodides,' gave probably the highest possible periodides, viz., triodide of morphine hydroiodide, hexaiodides of strychnine, brucine and aconitine hydroiodides, and the octoiodide of atropine hydroiodide. Dr. M. Gomberg reported on 'A Periodide of Bromtriphenylmethane,' the only organic perhalide destitute of any element of the nitrogen family, except Victor Meyer's iodonium perhalide and Kastle's sulphonperiodide.

'On Tetraphenylmethane,' M. Gomberg.

'Hydrazo and Azo. Derivatives of Tetraphenylmethane,' M. Gomberg and A. C. Campbell.

'Camphoric Acid; Synthesis of the Neighboring Xylic Acid,' W. A. Noyes.

'The Propyl Phosphines,' Peter Fireman and E. G. Portner.

'The Action of Ethers on Phosphonium Iodide,' Peter Fireman and Ernestine Fireman.

'The Oxidation of Formic Aldehyde by Hydrogen Peroxide,' J. H. Kastle.

Dr. Charles F. Mabery reported a continuation of his great work on petroleum. In one paper, on the 'Unsaturated Hydrocarbons in Canadian Petroleum,' with W. O. Quayle, he stated that he had separated compounds containing seven, eight, nine and ten carbon atoms; a regular series of of sulphur compounds following the type of $C_nH_{2n}S$ beginning with C_9. Some sulphoxides according to the type $C_nH_{2n}SO_2$ were formed from these compounds. In continuing his work with E. J. Hudson 'On the Constituents of California Petroleums' from different sources he found in some large amounts of aromatic hydrocarbons, benzol, toluol, xylols, etc., and smaller amounts of naphthenes; in others the reverse was the case. Dr. Mabery also gave a paper 'On the Constituents of Commercial Paraffine' and succeeded in separating, by distilling under reduced pressure, a series of hydrocarbons according to the type of C_nH_{2n+2} beginning with C_{14} up to C_{20}. Working with H. L. Schrom, he obtained only negative results in his 'Efforts to add Hydrogen to Acetylene.' Sodium, amalgam, aluminum, and zinc with sulphuric acid, electrolysis and passing a mixture with hydrogen

from zinc and sulphuric acid over heated platinum sponge.

'Oxy-induline—a New Blue Dyestuff,' S. P. Mulliken and W. Kelley. This compound, $C_{36}H_{26}N_4O_4$, is readily formed by heating amidophenol hydro-chlorate. Sulphonated it is a fast and direct blue dyestuff.

'The Benzaldoxines,' F. K. Cameron.

'On True and Bis-Nitroso Compounds,' E. Kremers.

Dr. T. W. Richards gave an interesting historical review of the 'History of Physical Chemistry.' In one sense we are not wrong in looking on physical chemistry as a modern invention. While many of the fundamental generalizations are by no means recent, the sharp line drawn thirty years ago between physics and chemistry are but lately erased, and it is well accepted now that the same laws governing one class of phenomena are applicable as well to the other. Boyle, in the seventeenth century, discovered the law of the contraction of gases; Lavoisier forced the idea of the conservation of mass upon the scientific world. Dalton, Avogadro, Ampere, Gay-Lussac, Dulong and Petit, Davy and Faraday made great additions to our physico-chemical knowledge. Julien Robert Meyer and Helmholtz acquired a knowledge of conservation of energy. There were Hittorff's researches on electrolytic conductivity. Wilhelmy, forty years ago, worked on the speed of reactions along the lines suggested by Wentzel and Berthollet. The observations of these *savants* were used as a basis a decade later by Guldberg and Waage, when they promulgated the law of mass action as a result of the study of the progress and equilibrium of chemical change. Then why should it be regarded as new?

The growth of physical chemistry has not been commensurate with that of the other divisions of the science for several reasons, one of which was the necessity for dealing with the little understood subject of solutions. Van't Hoff having shown that substances in solution follow the same laws governing the aëriform state, and Arrhenius having explained the difference between solutions conducting electricity and non-conductors, the progress has been very rapid in the last ten years. Professor Richards attributed another cause as summed up in the word 'prejudice.' "Not only have untenable theories been held long after their time, but whole fields of study have been neglected by most chemists and physicists because they lay on the border line between the two sciences."

While higher mathematics is a most valuable instrument for a physical chemist, there is a serious danger of accurate mathematical processes leading to wholly erroneous conclusions because of incomplete or inaccurate data. One must be an accomplished physicist, chemist and mathematician to obtain the highest results in modern thoretical chemistry, and the number of men having time to acquire the necessary knowledge can never be large. Attention was called to the excellent laboratories of Nernst at Göttingen and Ostwald in Leipsic, and it was regretted that America did not have more men devoting themselves to pure science.

Dr. E. C. Franklin, in his paper on 'Some Properties of Liquid Anhydrous Ammonia,' showed that ammonia resembles water closely in all the properties which give water its unique position as a solvent. It is next to water as a general solvent for salts; there is a close resemblance in the power of dissociating electrolytes, some salts conducting even better in an ammonia than in a water solution. It forms ammonia of crystallization. Except water, its heat of volitization is greater than that of any other liquid. Its specific heat is as great as water.

'The Solubility of Di-ionic Salts of Weak Acids in Solutions of Stronger Di-ionic Acids,' A. A. Noyes and David Schwartz.

'The Solubility of Di-ionic Acids in Solutions of Di-ionic Salts of Other Acids,' A. A. Noyes and E. S. Chapin.

'The Solubility of Tri-ionic Bases in Solutions of Di-ionic Salts of Weak Bases,' A. A. Noyes and E. S. Chapin.

'The Solubility of Iodine in Dilute Potassium Iodide Solutions,' A. A. Noyes and L. J. Seidensticker.

Dr. A. A. Noyes, in this series of papers on 'Solubility,' showed that by means of equations the solubility of a substance in the presence of another can be calculated and so predicted.

'The Rate of Reaction between Silver Acetate and Sodium Formate; A Reaction of the Third Order,' A. A. Noyes and George T. Cottle.

'On the Influence of Silicon on the Heat of Solution of Coke in Cast Iron,' E. D. Campbell and W. E. Hartman.

'Passage of Bubbles through Media of Different Densities,' C. Gilbert Parker.

'Some Boiling-Point Curves,' F. K. Cameron and E. F. Thayer.

'Photographic Reproduction of Color,' Romyn Hitchcock.

'Sixteenth Annual Report of Committee on the Bibliography of Chemical Literature,' of which Dr. H. Carrington Bolton is Chairman. This report has been printed in SCIENCE.

The Sub-section of Physiological Chemistry met Friday afternoon in Room 8 Boylston Hall, Harvard University, a number of visiting physicians being present.

Dr. E. E. Smith, of New York, who was in charge of this division of the subject, gave the leading paper on 'American Research in Physiological Chemistry.' The beginnings of the application of chemistry to physiological research are twinned with the life of the American Association. It was inaugurated in 1842, when Meyer pointed out the valuable discoveries of Joule, Grove and Helmholtz in the domain of physics to the physiologists. Von Liebig's 'Animal Chemistry,' edited for the American profession by J. M. Webster, was the first important publication in America in this line, although in 1825 Dr. Beaumont, U. S. A., had obtained for the first time pure gastric juice in treating a gastric fistula from a gunshot wound. Dr. Caldwell, of Louisville, ridiculed Liebig's material views of the body as a 'corporeal stove for burning oxygen.' In the forties animal heat attracted the attention of physiologists, many of whom maintained that if the lungs were the stove the lungs should be hotter than the other parts of the body. Austin Flint (1862) found stercorin in human feces and that it differed from cholesterm by only two hydrogen atoms.

In 1869 Atwater prepared an essay on the composition of the American maize. Twenty-five years ago this same worker, in an address before the Maine State Board of Health, gave out the modern ideas of nutrition. All are well aware of the valuable work done now in various parts of the country by Dr. Atwater, or under his direction, upon the dietaries of people of different occupations in various localities. Aside from the scientific value of such observations, the economics of the question deserve the most careful consideration. Dr. Atwater has concluded that our national dietary is one-sided, and as the food production of the United States is out of balance, we should make use of a larger proportion of fuel materials, as fats and carbohydrates.

Probably the greatest problem of interest now is the study of proteids. The imperfect methods of separating these complex bodies have been greatly improved by Mallet and Wiley by the use of various saline solvents and precipitants, especially phosphomolybdic acid and bromine. Chittenden's work for the past fifteen years, Osborne's new nomenclature and crystal-

lization of vegetable proteids, and Hofmeister's separation of crystalline animal proteids, have yielded interesting conclusions in regard to the physiology of germination and plant growth in general.

Among the earliest metabolism experiments reported were those of Flint, who concluded that the secretion of urea was increased by muscular exertion. These ideas have been verified by subsequent investigations.

During the last few years the chemical factors causing certain diseases have been studied. Some claim that some complaints are due to increased presence of uric acid in the blood. Herter says that this acid is the result rather than the cause. Rachford presents evidence to show that the symptoms of toxicity are expressions of leucomaine poisoning dependent upon defective elimination. The importance of the subject is exhibited by the foundation and organization of the Institute of Pathology of the New York State Commission of Lunacy and the recent establishment of a professorship in pathological chemistry in the University and Bellevue Hospital Medical College, New York.

American contributions to physiological chemistry have hitherto been scattered in journals of chemistry, physics, medicine and general science at home and abroad. There are two journals published now in America dealing directly with the subject, *The American Journal of Physiology* and *The Journal of Experimental Medicine.*

Dr. S. Bookman, in his paper on 'Studies in Epilepsy; a Contribution to the Subject of Metabolism in Nervous Diseases,' gave conclusions based on chemical examination of stomach contents, blood and urine, together with urotoxic and serotoxic determinations in four cases. His other paper was on 'Investigations of the Nature of the Nissl Granules.' 'Proteids of the Brain' was Dr. P. A. Levene's paper.

'Experiments on the Metabolism of Matter and Energy in the Human Body,' by W. O. Atwater and F. G. Benedict.

'Experiments on the Metabolism of Alcohol in the Human Body,' by W. O. Atwater and F. G. Benidict, provoked not a little discussion, for, from the experiments reported, alcohol is a heat-producing food.

'On the Availability of Nutrients of Food Materials,' by W. O. Atwater and A. P. Bryant.

'A Dietary Study of a Bicycle Racer,' by W. O. Atwater and A. P. Bryant. The subject studied was Miller, the six-day champion racer of the world.

Changes in the ripening of cheese are usually attributed to micro-organisms, but Drs. S. M. Babcock and H. L. Russell, in a paper on 'The Properties of Galactase; a Proteolytic Ferment of Milk,' attributed the conversion of insoluble casein of a green cheese into peptones and other soluble proteids in ripened cheese to the important enzyme named in the title of the paper. Galactase appears to be allied to trypsin and is more abundant in cream, being precipitated by absolute alcohol. It is present in all milks; sheep, goat, horse, hog, buffalo, burro and human.

'Urinary Acidimetry and Alkalimetry,' Heinrich Stern.

'The Normal Degree of Urinary Acidity,' Heinrich Stern.

Dr. H. A. Weber, who was in charge of the subject of Agricultural Chemistry, gave a paper on 'Light: a Factor in Sugar Production.' The sugar content of plants is dependent upon climatic conditions, location and proximity to large bodies of water. For plants having short period of vegetation higher latitudes are more favorable, other things being equal.

'The determination of Starch in Agricultural Products,' J. B. Lindsey.

'A Note on the Growth of Lupins on Calcareous Lands,' E. W. Hilgard.

'Some of the Important Results of Recent Chemical Investigations of Plant and Animal Cells,' E. A. de Schweinitz.

'Composition of Ohio Wines,' A. W. Smith and Norman Parks. The ratio of glycerol to alcohol in native wines is usually taken as 7–14 to the 100. From pure wines made by the authors it varies from 3.9 to 11.8 to the 100 with an average of 5.

'The Determination of Turbidity of Water,' W. P. Mason.

'Efficiency of the Elmira Filtering Plant,' W. P. Mason.

Miss Isabel F. Hyams and Mrs. Ellen H. Richards, in presenting their paper, 'On the Composition of *Oscillatoria prolifica* (Greville) *O. rubescens* (de Candolle) and its Relation to the Quality of Water Supplies,' exhibited samples of the blue-green algæ found in Jamaica Pond, Boston, during the months of May, June and July. The algæ seem to be identical with that found in Lake Geneva in 1834–6, and later in Lake Mérat. During the growth of this moss the water assumes a brownish-red appearance, and on a hot, still day it separates out as a cream, which is easily driven by the winds upon the rocks, where it decays, giving off a disagreeable, fetid odor. While numerous substances were extracted from the moss, no ill effect is known which may be attributed to this source.

'The Le Seuer Electrolytic Process for the Production of Caustic Soda and Bleaching Powder,' read by Dr. C. L. Parsons, depends upon iron bars supporting a wire gauze as a diaphragm and the use of platinum-iridium anodes bound up in glass. In another paper, 'A Review of the Electrolytic Processes for the Production of Caustic Soda and Bleaching Powder,' by the same author, it was claimed that the process described would replace the Castner-Kellner and other processes on account of economy and efficiency.

'The Alum Question in Water Purification,' E. G. Smith.

Dr. C. F. Mabery and Mr. K. Landgrebe stated that 'The Effect of an Electrolytic Bath on the Tanning of Leather' was the reduction of the time consumed, and they observed that the percentage of nitrogen was lower in leather so tanned.

'Some Records in the Year's Progress in Applied Chemistry,' Wm. McMurtrie.

'The Progress in Utilization of City Garbage, with Special Reference to the New Plant in Boston,' Bruno Terne.

'On the Removal of Hardness from Water for Boiler Purposes,' C. F. Mabery and E. B. Baltzly. All kinds of hard water have from 90–98 per cent. of the lime present and all suspended matter are precipitated cold by treatment for twenty-four hours with half the calculated amount of sodium aluminate.

'New Process for the Commercial Production of Oxygen and its Industrial Applications," Romyn Hitchcock.

The meeting was most successful in every way.

CHAS. BASKERVILLE,
Secretary.
UNIVERSITY OF NORTH CAROLINA.

PHYSICS AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (I.).

SECTION B of the American Association was organized with Vice-President F. P. Whitman in the Chair. His vice-presidential address, on color-vision, printed in the issue of SCIENCE for September 9th, was well received and constitutes a *résumé* of the subject of great value.

The program of the section included fifty titles of papers, of which forty were read before the section. Many of these papers were of very high order and almost every one of them was creditable and interesting.

The Measurement of Thermal Conductivity in Iron. By Professor E. H. Hall, Cambridge, Mass.

The author pointed out that the method in which thin plates are used is unsatisfactory owing to the difficulty of determining the difference of temperature of the two faces. He obviates this by copper-plating the two faces of his iron plate and by using the copper-iron thermocouples thus formed for determining the temperature difference. He finds that the conductivity of iron increases as the temperature is decreased at the rate of about one per cent. for eight degrees Centigrade.

On the Magnetic Deflection of Diffusely Reflected Cathode Rays. By Professor Ernest Merritt.

On the Electrical Properties of the Vapor from the Arc. By Professor Ernest Merritt and O. M. Stewart.

Professor Merritt finds that diffusely reflected cathode rays are deflected by a magnet to the same extent as the same rays before reflection. Professor Merritt and Mr. Stewart find that the vapors from the electric arc produce electrical discharge in a manner similar to the action of a gas which has been exposed to X-Rays. Vapors from the negative carbon discharge negative charges more readily than positive charges.

In their report on the Velocity of Light in the magnetic field Professors E. W. Morley, H. T. Eddy and D. C. Miller described their interferometer, the two optical paths of which consist of tubes of carbon bisulphide surrounded by very large magnetizing coils. These coils were wound in halves which could be connected differentially or directly at will. It was found that the velocity of light in CS_2 is not altered by one part in sixty millions by a magnetic field of such intensity as to rotate the plane of polarization 180° in 60 cm.

A Study of Galvanic Polarization. By Barry McNutt, South Bethlehem, Pa.

The author finds that the polarization of a $Cu-CuSO_4-Cu$ cell (and the same is true of cells of silver and of zinc) is not zero with infinitesimal (?) current.

A Lecture Room Experiment in Electrostatics. By Professor W. S. Franklin, South Bethlehem, Pa.

The author exhibited an experiment illustrating the instability of electrified liquid films. A brass ladle with a sharp lip is nearly filled with melted rosin; it is then electrified, by joining it with an electrical machine, and tilting until the rosin runs in a thin layer over the lip, when it is blown out in a cloud of silky threads highly electrified.

The Most Efficient Thickness of Transformer Plates. By Professor F. Bedell, R. M. Klein and T. P. Thompson, Ithaca, N. Y.

On plotting the curve showing the relation between the thickness of the plate and the total loss due to hysteresis and eddy currents it is found that the curve has a broad, flat minimum extending from about 10 to 15 thousandths of an inch in thickness of the plate.

Proposed Methods of Determining the Frequency of Alternating Currents. By Karl Kinsley, Falls Church, Va.

Mr. Kinsley advised using a clamped, free bar provided with an adjustable rider and set in vibration by an electro-magnet actuated by the current to be studied.

A New Gas. By Charles F. Brush, Cleveland, Ohio. (Printed in Science for October 14th.)

Polarization and Internal Resistance of the Voltaic Cell. By Dr. Karl E. Guthe, Ann Arbor, Mich.

Graphical Treatment of Mutually Inductive Circuits with Special Reference to the Case of Variable Frequency. By Professor H. T. Eddy, Minneapolis, Minn.

The Hysteresis of Iron and Steel at Ordinary Temperatures and at the Temperature of Solid Carbon Dioxide. By A. M. THIESSEN, Ithaca, N. Y.

IT was found that the hysteresis loss for constant magnetizing fields increases with the temperature if the field is weak, but the opposite is the case when the iron is nearly saturated.

Some Determinations of Dielectric Strength. By PROFESSOR THOMAS GRAY, Terre Haute, Ind.

STEP-UP ring transformers were used and the potential difference was determined by an electrometer. It was found that the dielectric strength for air is the same for alternating currents of ordinary frequency as it is for static charges.

A Study of Standard Meter Scales ruled on Nickel, Silver and Glass. By PROFESSOR D. C. MILLER, Cleveland, Ohio.

AFTER an exhaustive study of scales of various kinds Professor Miller concludes that nickel scales are far superior to those in common use, and indeed as good as platinum iridium, except that they have a somewhat higher coefficient of expansion. His nickel bar, made by the Geneva Society, is very accurately divided, and he has calibrated it throughout by the international method.

An Instrument for Measuring Radiance. By PROFESSOR KNUT ANGSTRÖM.

THE instrument was exhibited by Mr. E. S. Ferry, and consists essentially of two bolometer strips, one of which is heated by the radiance to be measured and the other is heated to the same temperature by an electric current, from which the absolute valve of the radiance may be calculated.

A Redetermination of the Ampere. By GEO. W. PATTERSON and KARL E. GUTHE, Ann Arbor, Mich.

THE authors used an electrodynamometer the moment of whose coil was balanced by the torsion of a wire of small elastic fatigue. The work seems to have been done with extraordinary care and gives 0.0011192 grams per sec. per ampere for the electrochemical equivalent of silver. This reconciles the difference between Rowland's value for the mechanical equivalent of heat and that obtained by electrical methods. The paper occasioned a great deal of favorable comment.

Progress in the Exploration of the Air with Kites at the Blue Hill Observatory. By A. LAWRENCE ROTCH, Director.

On the Osmotic Pressure of certain Ether Solutions and the Validity of the Boyle-Van't Hoff Law. By PROFESSOR H. M. GOODWIN and GEO. K. BURGESS, Boston, Mass.

IT was shown that the Boyle-Van't Hoff law holds as a first approximation only.

On the Dielectric Constant and Electrical Conductivity of Liquid Ammonia. By PROFESSOR H. M. GOODWIN and MAURICE DE KAY THOMPSON, Boston, Mass.

IT is found that the dielectric constant of liquid ammonia is less than it is for water, while the electrical conductivity of solutions of salts in ammonia is greater than it is for solutions of the same salts in water.

The two reports and five papers following were read in joint session with Section A.

Report on the Recent Progress in the Dynamics of Solids and Fluids. By PROFESSOR ERNEST W. BROWN, of Haverford College, Pa. [To be printed in SCIENCE.]

Report on the Recent Progress in the Mathematical Theory of Electricity and Magnetism. By PROFESSOR ARTHUR G. WEBSTER.

The Mass and Moment of Inertia of the Earth's Atmosphere. By PROFESSOR R. S. WOODWARD, Columbia University, New York.

PROFESSOR WOODWARD pointed out our ignorance of the necessary data and gave the results arrived at by making various hypotheses.

Temperature and Vapor Gradients in the Atmosphere. By Professor F. H. Bigelow, Washington, D. C.

Two New Forms of Apparatus for Measuring the Acceleration of Gravity. By Professor R. S. Woodward.

The author suggested the use of the vibrations of a weight hung from a helical spring. Professor T. C. Mendenhall suggested the use of a flat ring as a pendulum, the only linear measurement required being the external diameter of the ring.

The Structure of Cyclones and Anticyclones. By Professor F. H. Bigelow.

The Gravitation Constant and the Mean Density of the Earth. By Professor R. S. Woodward.

Professor Woodward pointed out a new form of the relation between these two quantities.

On the Relative Brightness of Pigments by Oblique Vision. By Professor F. P. Whitman, Cleveland, Ohio.

Professor Whitman used the flicker photometer and found that the brightness at the red end of the spectrum decreases as the vision becomes more oblique, while the opposite is true (but to a less extent) at the violet end. The brightness of yellow-green is nearly independent of the angle.

A New Instrument for the Measurement of the Intensity of Sound. By Professor A. G. Webster and Mr. B. F. Sharpe.

The method consists in measuring, by means of an interferometer, the amplitude of vibration of a thin glass plate. The interference fringes are photographed on a revolving drum. The constants of the instrument can be experimentally determined and the intensity of the sound can be calculated in absolute terms.

Exhibit of an Automatic Mercurial Air Pump designed by Professor E. W. Morley. By Professor D. C. Miller.

The peculiar advantages of the pump are that it need not be situated near the automatic controller, and that the mercury does not come in contact with rubber. It can be actuated with a water pressure of 20 pounds per square inch and can produce a vacuum of 1-500,000,000 of an atmosphere.

An Apparatus for demonstrating in Alternating Currents the Change of Phase due to either Inductance or Capacity. By Professor Sidney T. Moreland, Lexington, Va.

An Apparatus for determining Coefficients of Induction. By Professor Sidney T. Moreland.

This apparatus consists of two coils at right angles, producing a rotating magnetic field when alternating currents of different phase are sent through the two coils. A copper cylinder is suspended in this rotating field and indicates the phase relations of the two currents.

An Improved Method for rating Tuning Forks. By J. O. Reed, Ph.D., Ann Arbor, Mich.

The method is a modification of that used by Professor Michelson, but instead of using an electric spark Dr. Reed employs the flash of light from a mirror rotated by a secondary pendulum, which is in turn compared with the standard clock.

A New Chronograph and a Means of Rating Tuning Forks. By Professor A. G. Webster.

The chronograph is actuated by a small motor regulated by a tuning fork.

A Geometrical Method for Investigating Diffraction by a Circular Aperture. By Professor A. G. Webster.

Professor Webster obtains a kind of 'rachet' Cornu's spiral for this case of diffraction, that is a spiral having Cusps.

Study of Elastic Fatigue by the Time Variation of the Logarithmic Decrement. By Professor J. O. Thompson.

Photographic Studies of the Electric Arc. By N. H. BROWN, Ithaca, N. Y.

On the Efficiency of Condensers. By PROFESSOR E. B. ROSA and ARTHUR W. SMITH, Middletown, Conn.

THE authors give results determined by their resonance method, which was described at the Detroit meeting.

A Calorimetric Determination of the Energy Dissipated in Condensers. By PROFESSOR E. B. ROSA and ARTHUR W. SMITH.

The Effect of Fibrous Structure in Iron on its Change of Length when Magnetized. By E. RHOADS, PH.D., Baltimore, Md.

Notes on the Effect of Silicon on the Magnetic Permeability of Iron. By PROFESSOR F. C. CALDWELL, Columbus, Ohio.

IT was found that the permeability increases with the amount of silicon present in the iron.

On the Measurement of Electrical Oscillations of Short Period and their Absorption by Water. By PROFESSOR A. D. COLE, Granville, Ohio.

THIS is a continuation of the work which was reported by Professor Cole to Section B at Buffalo.

An Acoustical Micrometer. By J. O. REED, PH.D., Ann Arbor, Mich.

ITS principle consists in measuring the amplitude of vibration of a stretched membrane.

Polarization in the $Zn - H_2SO_4$ Cell. By PROFESSOR W. A. ANTHONY, New York City.

AFTER an extended research into the effect of saturating the acid with hydrogen, oxygen and carbon dioxide, Professor Anthony concludes that what is called polarization is not due to the accumulation of hydrogen, but to the fact that the oxygen originally dissolved in the acid and condensed on the plates has been used up.

The Heat of Fusion of Ice Determined in Electrical Units. By PROFESSOR E. L. NICHOLS, Ithaca, N. Y.

The Electrical Resistance of Lead Amalgams at Low Temperatures. By G. W. GRESSMAN, Ithaca, N. Y.

THE most striking fact reported in this paper is the sudden decrease in resistance upon solidification, the resistance of the solid amalgam being sometimes as low as one-fifth of the resistance of the fluid amalgam at its freezing point. If the thermo-electrical explanation—based on heterogeneity—of excessively high resistance of alloys is correct one would expect an increase of resistance upon solidification, for it is then that the alloy becomes heterogeneous.

N. ERNEST DORSEY,
Press Secretary.

THE ADVANCE OF PSYCHOLOGY.*

THE American Association for the Advancement of Science, when it first met fifty years ago, had no place for anthropology nor for psychology. Science has its origin in the practical needs of society. In a new country of great area and rich resources the energies of its people were directed to invention and exploration. The spirit of Franklin led to the development of railways, steamboats and telegraphy, to the building of cities and the search for mines.

But not only in America and in the case of the anthropological sciences have fifty years brought great changes. Science has become a leading factor in modern life by the rapidity rather than by the duration of its growth. Our own revered Dr. Hall might have talked with Herschell, who could almost have touched the hand of Newton. Newton was born the year that Galileo

*Address of the Vice-President of Section H—Anthropology—of the American Association for the Advancement of Science, August, 1898.

died. If Copernicus had lived to extreme old age he might have handed the *De Orbium Celestium Revolutionibus* to Galileo. While the whole history of science is thus nearly spanned by five lives, modern science is scarcely older than our Association. It was only in the decade of its foundation that the doctrine of the conservation of energy was announced, while the *Origin of Species* was published in the year of our eleventh meeting. If the physical sciences, as we now understand them, are scarcely more than fifty years old, and the biological sciences are only forty years old, the anthropological sciences are still younger. Perhaps these are now in the condition of the physical sciences before they had become truly exact, of the biological sciences before they had become truly genetic.

It is easy to prophesy after the event, and from our present point of view science in its history appears to have followed a necessary course. The phenomena of the physical world are stable and readily subject to experiment and measurement; their control is essential to material progress. It is, therefore, no wonder that the physical sciences should have preceded the biological sciences in their development. Far more complex, transient and inaccessible to experiment even than the phenomena of living beings are men, they themselves and their deeds—sciences of these things must come late. As man has been evolved from simpler forms of life, and these were preceded by a lifeless earth, so the sciences dealing with man, with life and with matter must be based one upon the other. The history of science is, therefore, full of promise for the student of anthropological science. We may grant the past to others and claim the twentieth century for our heritage. Perhaps our Copernicus, our Newton, our Lavoisier, our Darwin is one of the younger members of this Section.

It may, however, be that the subject-matter of the anthropological sciences is such that they will proceed without catastrophe. The form of the earth is altered by earthquakes on occasion, but every day it is molded to a greater degree by less obtrusive agencies. In the making of the anthropological sciences by the collecting and arranging of facts, by discovery and by generalization, we have every reason to be satisfied with the part taken by America and by this Association. In many sciences we must at once yield the leadership to older nations. In the youngest of the sciences we at least stand on terms of equal service. It was perhaps by special providence that last year's meeting of our Association was presided over by an anthropologist, but this year we chose to celebrate our fiftieth anniversary under a member of this Section. That this Section should have supplied three of our last five presiding officers and our permanent secretary for twenty-five years; that the British Association should have come to America to establish its Section of Anthropology and on its second visit should have chosen an anthropologist for its president—these things we may at least regard as an omen of the place of anthropology in the science that is to be and of the place of America in anthropology.

While anthropology, largely owing to the richness of the material at hand and to the great Bureau of American Ethnology established to investigate this material, has come to such fruition in America, psychology has also shown great vitality. Unlike anthropology, psychology is distinctly a university discipline. For reasons chiefly theological, ethical and educational, mental and moral philosophy had been taught from the foundation of our colleges by the president of each institution to all students. It happened that at the same time that psychology had developed into a science, the college president became an executive

officer, no longer chosen as a matter of course from the clergy, having neither time nor training for the teaching of mental science. There was thus an empty place which the modern psychologist was prepared to fill. Further, the rapid development of the college into the university with elective courses permitted psychology to compete on equal terms with the older sciences, and the result has been its secure establishment in the university. Indeed, psychology, touching with one hand philosophy, the humanities and the historical and political sciences, while with the other hand it reaches toward the natural and exact sciences, bids fair to become central. Thus, at Harvard, Professor Münsterberg's elective course in empirical psychology was this year followed by 365 students. At Yale Dr. Scripture's course in physiological and experimental psychology was elected by 138 students. There were last year given by American universities 18 doctorates with psychology as the major subject —more than in any science except chemistry, six times as many as in astronomy and nine times as many as in anthropology.

Psychology, though its recent development has been so rapid, is not a new science; it should rather be regarded as one of the oldest of the sciences. Under the great dynasty of philosophers—founded in Greece, not extinct even during the Dark Ages, reestablished after the Renaissance—all the sciences were developed. From Aristotle to Kant the history of philosophy is in large measure the history of science. But as the domain of knowledge became too great to be ruled by a single mind it must needs be divided into the principalities that we call the sciences. From the beginning psychology has been the favored nursling of philosophy, and, as the other sciences were taken from it, all the more did it cherish that which was left. In Great Britain Locke, Berkeley and Hume and their English and Scottish successors to the present time have been at once students of philosophy, and of psychology. The same may be said of Herbart, Lotze, Wundt and many more in Germany and in France. In our own country to-day we find many of our leaders—James, Ladd, Royce, Dewey, Fullerton and others—professing equally philosophy and psychology.

Psychology, under the guidance of philosophy, became at times somewhat schematic and unreal, though never I think unfruitful or regressive. It needed, however, to be cross-fertilized with the natural sciences. These sciences, in their development, could not ignore the senses and the mind. Perceptions are parts of a physical system, but they are also parts of an individual consciousness. Newton not only analyzed light, but also named seven colors; Dalton found that he was blind to certain of them; Young invented a theory to account for their combinations; von Helmholtz reviewed the phenomena in one of the greatest of books. Physiology on its side could not study the senses and brain while ignoring the functions that they subserve, and it was found that the methods of natural science could be applied in psychology. The zoologist could not neglect the mental life of animals and the place of consciousness in evolution. Darwin wrote not only *The Origin of Species*, but also *The Descent of Man* and *The Expression of the Emotions*, and was the first to study the development of the child's mind.

The subject-matter having been supplied by philosophy and the methods by natural science, the way was made ready for the establishment of a science of psychology. This we owe largely to the intellectual patience of Germany, tired at last of the Hegelian metaphysics. Lotze published his *Medizinische Psychologie* in 1852; Fechner his *Elemente der Psychophysik* in 1860; Wundt his *Menschen und Thierseele* in 1863, and his

Physiologische Psychologie in 1874. Lotze and Wundt were doctors of medicine; Fechner was a professor of physics; they were all deeply interested in philosophy. Psychology, as pursued to-day, is deeply indebted to these three, perhaps chiefly to Wundt, who, continuing his services, founded in 1879 the first laboratory of psychology, and established in 1883 a journal for the publication of its investigations. Following and leading this psychological movement we find in Germany men such as Stumpf, Lipps, Ziehen, Müller, Ebbinghaus and many more. One of them—Münsterberg—has come to us, while Höffding, of Denmark, may be included in the same group. Physiologists, such as Hering, Aubert, Preyer, Flechsig, Exner and von Kries, and physicists, such as von Helmholtz, Mach and König, may reasonably be claimed, in part at least, for psychology.

In France a philosopher, as Cousin, or a man of letters, as Taine, may have accomplished somewhat, but modern writers and workers, as Ribot and Binet, have been largely influenced by Germany. France has, however, made two independent contributions of importance, though in both cases chaff has been mixed with the grain. These are, on the one hand, abnormal and pathological psychology and, on the other hand, individual and social psychology. In Italy the names of Lombroso and Mosso remind us of work in criminology and in physiology that has become important for psychology, as is also the case with the histological work of the Spaniard, Ramon y Cajal. In Russia performance waits on promise.

Great Britain has developed a modern psychology without breaking with its traditions. It has always been a land of great individuals, and Locke, Berkeley and Hume have found worthy successors in Bain, Ward and Stout, to mention only three living psychologists belonging to three different generations. Darwin, Huxley and Spencer, while establishing the theory of evolution, gave mind its due place, Spencer having concerned himself especially with mental and social evolution. Romanes and Lloyd Morgan have directed attention to the study of animal intelligence, while Galton's contributions to anthropometry and heredity have exhibited great originality. Experimental psychology has not made much headway in Great Britain. They have let us take from them Titchener; so he must count for America. The first laboratory, at Cambridge, was founded by me, and maintains a humble existence. Within a year a laboratory has been founded at University College, London, and Oxford has at least awakened to the existence of experimental psychology to the extent of decreeing this summer that it shall *not* be taught under a newly established lectureship of mental philosophy.

This American Association is naturally most concerned with what has been accomplished for psychology in America. The history of psychology here prior to 1880 could be set forth as briefly as the alleged chapter on snakes in a natural history of Iceland—"There are no snakes in Iceland." The eminence of the theologian Jonathan Edwards is witness to the lack of any psychologist. We had only text-books by college presidents setting forth Scottish realism. Porter, of Yale, gave us the best of these books, but McCosh, of Princeton, performed a greater service by placing the aegis of theological conservatism over both organic evolution and experimental psychology.

But the land lay fallow and twenty years ago the seed was sown. James, at Harvard, began the publication of a series of striking articles, culminating in the issue, in 1890, of *The Principles of Psychology*, a work of genius such as is rare in any science or in any country. Hall, in 1883, established in the

Johns Hopkins University the first American laboratory of psychology—the second in the world *—since transferred to Clark University. The *American Journal of Psychology*, founded by him in 1887, shows the value of the work accomplished at Johns Hopkins and Clark, while the *Pedagogical Seminar* bears witness to his influence in stimulating interest in the child's development. Ladd published, in 1887, his *Elements of Physiological Psychology*, a work that has exerted great influence both here and abroad. It has been followed by a series of treatises on psychology that have never been equalled in range and thoroughness.

Under James, Hall and Ladd and in Germany there was then trained a second generation of psychologists, and we ourselves now have our students, a third generation. The second American laboratory was under my direction at the University of Pennsylvania. The first chair in psychology was there established and courses in laboratory work were there first given. This was only ten years ago. The work at Pennsylvania is continued under Witmer, while at Columbia we have since 1890 a laboratory and a range of courses in experimental, physiological and analytic psychology which may bear comparison with those of the other sciences. Baldwin carried modern psychology, himself enlarging it as he went, from Princeton to Lake Forest and thence to Toronto and back to Princeton. The laboratory established by him at Toronto is continued under Kirschmann, while at Princeton he has founded an efficient laboratory, and by his work on genetic psychology has brought our science into fruitful relations with zoology and sociology. Jastrow, at Wisconsin, stands forward as a leader in experimental psychology having accomplished much for the advancement of the science and the diffusion o its results. In the latter connection may be mentioned the psychological laboratory under his direction at the Columbian Exposition and the fact that almost alone he has represented psychology in this Association.

The great services for psychology of James at Harvard, Hall at Clark and Ladd at Yale were not confined to their own publications, but were also directed toward building up strong departments. Harvard, with James, Münsterberg, Royce,Santayana, MacDougal and other men in closely related departments, surpasses every other university in the world in its opportunity for psychological study and research, and there is quite as much reason for German students to come to Harvard as for our students to go to Germany. Clark, where Sanford has charge of the laboratory, may almost be said to be a university for the advancement of psychology. The laboratory at Yale, under Scripture, has shown great activity and is able to publish annually a volume of researches. Cornell, under a president who is a student of philosophy and psychology, has robbed Great Britain of its best exprimental psychologist, and under Titchener the laboratory stands quite to the front, while the courses in philosophy and psychology are especially well developed. Chicago early recognized the importance of psychology. Securing Dewey and Mead from Michigan and Angell for experimental work from Minnesota, in psychology, as in other departments, its development has been marvellous. Michigan and Minnesota have found other men to continue the work, while Stanford, California, Indiana, Iowa, Illinois and all the great State universities have established laboratories and given an adequate place to psychological courses.

*It would be more correct to regard the laboratory established about the year 1875 by James in the Scientific School of Harvard University as the world's first psychological laboratory. It was, however, nominally under physiological auspices.

It would be possible for me to give other objective proofs of the progress of psychology—the establishment, in 1894, of a second journal, *The Psychological Review*, which during the first six months of the present year published some 900 pages, all we hope contributing to the advancement of psychology; the prominent place given to psychology in our journals of education, philosophy, general science and popular literature; the widespread amateur interest in child-study and psychical research; our Psychological Association, with a membership of 102, all engaged in advancing psychology—these and other witnesses for psychology might be called upon to testify, but the development of psychology in the university has seemed to me best deserving of extended comment. Until the State shall learn to care for those who do the most for it, until those who are engaged in advancing knowledge shall work for the State and be supported by the State our universities will be the centers for research, and the position of a science in the university will measure its opportunity and fruitfulness. Very significant for psychology, therefore, is its progress in the universities of America during the past twenty years.

My remarks have been confined to the externals of psychology. Its inner history, its present content, its future outlook are not subjects that can be readily brought up and dismissed in a few words. Psychology is the most complex of the sciences. I do not at all claim that it is the most important of the sciences. The human race got on without it very well and could doubtless continue to do so. Its practical applications do not compare in importance with those of many of the sciences; it is in a way lacking in great discoveries and universal laws. But, compared with psychology, a science such as astronomy may almost be regarded as naïve. The entire known performance of the solar system and of the fixed stars since the time of the Chaldæans is less complicated than the play of a child in its nursery for a single day. The stars are so far away, the telescopes are so big, eclipse expeditions proceed to such remote quarters of the earth, that the simplest items of information take on a dramatic interest. Atoms and molecules are so invisible, the ether is so intangible, we know after all so little about them, that it is easy to invent hypotheses that do not contradict our ignorance. The generalizations of physical science are, indeed, the greatest achievements of the human intellect, but the intellect, by which and for which these generalizations have been created, when itself made the subject-matter of a science, is complex beyond those sciences which are its offspring.

Psychology does not, of course, claim as its subject-matter all 'that is in heaven above, or that is in the earth beneath, or that is in the waters beneath the earth.' The physical and natural sciences, language, literature and the fine arts, industries and institutions have, it is true, their origin and end in the mind, but this does not turn them into departments of psychology. The physicist no more needs to concern himself with the mental processes leading to his discovery than does the hen with the processes preceding the laying of its egg. The kind of novel called psychological is by no means a product of science. The enjoyment of art decreases as we analyze its products. Scientific prevision and guidance have scarcely more to do with the rise and decline of institutions than with the rise and decline of the sun in the firmament.

Still I do claim that there is no department of knowledge or activity which does not have an aspect that concerns psychology, and while hitherto it is psychology which has learned from sciences preceding it in their development, the time will come, and perhaps has now come, when every

science must take into account the facts and theories of psychology. The increase of knowledge which has caused the creation of the separate sciences is now leading to further specialization, but not in the sense of one science more completely ignoring the others. Rather we have at present well established sciences, such as astrophysics, physical chemistry, biology and others which take their subject-matter from two or more of the older sciences. It is probable that students in increasing numbers will take up the inter-relations of psychology with other sciences. Indeed, this tendency is already well marked. Mathematics is necessary as a tool for psychology, while conversely several books have recently been published concerned with the psychological presuppositions of mathematics. The fundamental concepts of mechanics have been treated as mental products by Mach, Pearson and others. At the present moment the Vice-President is giving, before the Section of Physics, an address on the perception of light and color, while the same subject was chosen by Sir George Stokes last month for the subject of his address before the Victoria Institute. Physics is, however, leaving to psychology vision, hearing, etc., though in the meantime new departments, destined perhaps to become new sciences—represented by the great works of von Helmholtz, *Physiologische Optik* and *Tonempfindungen*—are being created, which draw their materials in equal measure from physics, from physiology and from psychology. Errors of observation, the personal equation, the relation between mental and physical intensity, are subjects where the investigations of the psychological laboratory must be applied in astronomy and the other physical sciences. Chemistry, geology and botany perhaps stand most remote from psychology. Still, if physiology is in large measure the chemistry of living tissues, chemistry may be brought into intimate relations with psychology. Geology and anthropology are closely related, while physical geography is especially concerned with the relations of man to the earth. Many of the problems of evolution, so essential for psychology, are best studied in plants, and the applications of botany in agriculture, etc., are determining factors in the evolution of man.

Physiological psychology is already accepted as a distinct discipline, while zoology and psychology are equally intertwined. It is impossible to separate physical and mental evolution—witness the writings of Darwin, Spencer, Huxley, Romanes, Cope, Morgan and many more. Under the classification of this Association anthropology and psychology are included in one section. Several of our leading members would make psychology a branch of anthropology, while psychology regards ethnology and archæology, on the one hand, and somatology, on the other, as contributing much to its subject-matter. Sociologists find it somewhat difficult to disentangle their field from that of psychology.

If we turn to the departments of knowledge not represented in this Association—the humanities—we find psychology to be a connecting link between them and the physical and natural sciences. If we regard the professions—medicine, law, theology, teaching, journalism—we find that their products when systematized into sciences give to psychology and take from it. Literature and the fine arts, both in their origin and in their end, may be studied as departments of psychology, though it does not appear that psychology has as yet been of great service to them.

I may illustrate the inter-dependence of psychology and other sciences by a definite example. Much is being written just now regarding the relation of consciousness to the brain. The question is: Do perceptions, thoughts, feelings, volitions stand in causal

interaction with the brain, or are they an epiphenomenon, accompanying changes in the brain but not influencing them? Are our ordinary actions complex reflexes due to physical stimuli and the structure of the nervous system, or are the changes in the brain that precede movements initiated and directed by consciousness? The question is one of facts, that should be settled by scientific methods; and the solution will by no means concern psychology alone. The two greatest scientific generalizations of the present century are the conservation of energy and evolution by survival of the fit. Now, if consciousness alters, however slightly, the position of molecules in the brain the fundamental concept of physical science must be abandoned. If consciousness have no concern in the actions of the individual we have one of the most complex results of evolution developed apart from the survival of useful variations, and the Darwinian theory has failed. Surely both the physicist and the biologist must watch the steps toward the solution of a problem that concerns them so nearly.

The world is one world; every part of it is in relation to every other part, and each part consists in these relations. As a hand cut off from the rest of the body is no longer a hand, as a man apart from other men is no longer a man, so each science and each scientific fact and law has its value and even its existence in its relation to the totality of knowledge and of life. Psychology has become an integral part of modern science; it gives and takes with a free hand. A parvenu among the sciences, it is self-conscious and knows its obligations and its limitations; but its position in the body scientific is henceforth secure.

I have said that psychology is in a way lacking in great discoveries and universal laws. If I were addressing an audience of psychologists it might be desirable to consider whether this is due to the subject-matter or only to the immaturity of our science. Under present circumstances it is perhaps better in part to question my own statement. Columbus discovered a new world; Copernicus discovered innumerable worlds; but Descartes discovered, or at all events invented, the soul. Which after all was the greater scientific advance? Columbus did not foresee four hundred years of history, the present unequal conflict of a powerful nation with a declining civilization. Descartes' ideas of the relation of mind and body are not ours. But is not the very subject-matter of psychology one of the greatest discoveries of modern science? To unite strict idealism with strict materialism; to give consciousness its central place in the universe and yet to show that each change in consciousness is correlated with a change in the nervous system—this I claim to be a scientific generalization comparable to that of the conservation of energy or of organic evolution.

Minor but clear-cut discoveries in psychology have not been lacking—witness color-blindness, individual types of mental imagery, the dependence of emotion on reflex bodily movements, hypnotism, etc. Neither are quantitative formulas denoting relations among mental states or between mental and physical change lacking. Recent researches on subjects such as the perception of space, illusions of sense, color-vision, the time of mental processes, memory, fatigue and many more represent scientific advances as definite, interesting and important as those of physics or of zoology. Psychology has been able to adopt the quantitative methods of exact science and the genetic methods of of natural science, while its older methods of description and analysis witness an insight and acuteness unrivaled by any other science.

I have said that the practical applications of psychology do not compare in importance with those of many of the other sciences.

Here again, while a society of psychologists might properly discuss the causes of this limitation, in an address confined to generalities, it may be more profitable to point out that daily life consists in the application of such psychological knowledge as is at hand. How could Bismarck and Gladstone direct contemporary history except by superior insight into the way men act and the methods of influencing their actions? What have Wagner and Browning done except excite interest and emotion? The conduct of every profession and of every business is chiefly based on the adjustment of thoughts, feelings and actions. Systems of government and education are simply methods for controlling and directing the human mind. Now, of course, all this is done by the rule of thumb entirely uninfluenced by psychology as a science. The savage who kills a bird with a stone is not thereby shown to be a zoologist and a physicist. Still he does have a kind of knowledge of the habits of animals and of the laws of projectiles, whence have developed the sciences which, in the course of time, have turned back to daily life those applications of science in which modern civilization consists. Whether the history of the material sciences will be repeated in the case of the mental and social sciences it is not possible to say or to gainsay. There are at present indications of the application of psychology in the treatment of diseases, in education and in other directions. Evolution, careless of the individual, has proceeded with boundless waste; certainly we are now interfering with its course for our benefit. It may be that some day the applications of material science will be subordinate to those of psychology.

These things lie on the knees of the gods. What the future will bring we do not know, but the past is ours. When we regard the fifty years of this Association or the century now ending we cannot fail to see that it has been an era of science. German music, English poetry, the modern novel—these are great achievements, but scarcely comparable to the forward movement in science. The older sciences have been reformed and new departments have been established. But amid all this scientific progress nothing has been more notable—at least from my own partial point of view—than the development of psychology into a science rivaling in activity and fruitfulness the other great sciences.

J. MCKEEN CATTELL.
COLUMBIA UNIVERSITY.

THE SENFF ZOOLOGICAL EXPEDITION TO THE NILE VALLEY.

THE chief object of the expedition was to procure the life-history of *Polypterus* and its bearings upon the problem of the relation of the Crossopterygian fishes to the Amphibia. In the last few years the former theory that Amphibia sprang from Dipnoan fishes has gradually given way to the present view that *Dipnoi* are to be regarded as parallel to Amphibia from a common Crossopterygian origin.

Several very successful expeditions have been recently sent out to procure material for the embryology of Dipnoans, notably that of Richard Semon from Jena and that of Graham Kerr from the University of Cambridge. The former secured the complete life history of *Ceratodus*, and the latter brought back the embryology and complete life history of *Lepidosiren*, a South American form. In the meanwhile nothing has been done upon the development of *Polypterus* because of the exceptional difficulties which stood in the way of procuring material. The fish is abundant in the unhealthy equatorial zone of Africa, being recorded on the West Coast rivers as well as in Central Africa. It is also found in the Nile, but the Upper Nile, where it probably occurs in greatest abundance, has not been open to

naturalists during the occupation by the Mahdi.

Upon learning of the importance of this investigation, Charles H. Senff, Esq., of New York City, very generously contributed the greater part of the funds for the purpose, and the full equipment was made by the Zoological Department of Columbia University, with the assistance of Professor Osborn. Mr. N. R. Harrington, Fellow in Zoology, and Dr. Reid Hunt, Tutor in Physiology, volunteered to go to any part of Africa where it seemed most probable that embryonic stages could be secured. On reaching London they consulted with Dr. Boulenger and Professor Günther, also with Mr. Henry M. Stanley and Miss Mary H. Kingsley. The advice of these and many other naturalists and African explorers being strongly against the West Coast, it finally appeared best to choose the Nile Valley. The progress and results of the work may be extracted from Mr. Harrington's report. H. F. O.

Leaving New York on April 23d, we spent two weeks in London, making inquiries about Old Calabar, the Congo, Senegambia and Egypt. The rains having been prevalent on the West Coast for a month, the presumption was that the fish had already spawned there. Further, information was gathered in London which led us to think that *Polypterus* spawned in Lake Menzaleh, a connection of the delta of the River Nile.

On May 26th we reached Cairo, where permission to fish, interpreter, assistant and outfit were obtained. We were received by the Under-Secretary of State, Clinton E. Dawkins, as guest of the Egyptian government, and given laboratories and apartments in the capacious Fisheries plant near Damietta. The sympathy of the Egyptian government with pure scientific work was demonstrated by the repeated favors shown us.

But after three weeks' search we found that *Polypterus* did not occur in Lake Menzaleh during the low Nile period, and starting for the nearest point on the river we searched along the banks of the Nile until we came upon several *Polypterus* near Ras-el-Ghelig. From this point we explored carefully for 377 miles, having as many as thirty fishermen at work at one time in promising regions. The result was that on June 22d we settled down at Mansourah, forty miles from the sea, where we anchored for the summer over what was then the best *Polypterus* fishing ground not closed on account of the Anglo-Egyptian campaign.

The fish came in slowly, but, as a result of this, there was abundant time to study, to carefully inject, and to make the long-wished-for observations on living material.

The Nile being especially late in coming down, we remained at Mansourah until August 18th, and in our two months' stay accumulated a large number of the fish, beside very interesting and valuable cytological material from *Mormyrus*, *Malapterurus* and other Nile forms. After the 18th of August, when the tremendous flooding makes fishing in the river impossible, we worked in the canals, and, although we obtained fish as late as August 30th, the eggs were still immature. We sailed from Port Said September 10th.

As to the material brought back, it includes some beautiful invertebrate collections made in the Red Sea, numerous Elasmobranchs, lizards and general collections from the eastern Mediterranean, an admirable collection of Nile fishes (on which the Napoleonic expedition has left little undone in a systematic way), a still larger collection of the salt and brackish water fishes of Lake Menzaleh, and a considerable amount of morphological, neurological and cytological material of great interest.

N. R. Harrington.

FISHES NEW TO THE FAUNA OF SOUTHERN NEW ENGLAND RECENTLY COLLECTED AT WOODS HOLE.

DURING the past four years a rather large number of fishes, chiefly sub-tropical, have been collected by the U. S. Fish Commission at Woods Hole; some of these were not previously known on the Middle Atlantic and New England coasts, some had not before been detected in United States waters, one was new to the western Atlantic, and two were undescribed. Notwithstanding the continuous systematic collecting which has been carried on at this place for more than a quarter of a century, nearly every season yields unlooked-for additions, the present year being no exception. There are now known from the immediate vicinity of Woods Hole 222 species of salt-water and fresh-water fishes; this is a much larger number than has been reported from any other single locality in the United States except Key West, or, in fact, from any State north of Florida. Going back only to the all of 1894, the record of additions to the local fish fauna comprises 12 species belonging to 10 teleostean families; most of these are so interesting that they will be separately referred to, 5 being new to United States waters.

The mackerel family (*Scombridæ*), which was already very generously represented at Woods Hole by 10 species, added another member in 1895, when a specimen of long-finned albacore (*Germo alalunga*), 3 feet in length, was taken in the harbor. This pelagic fish is known from the Pacific, the eastern Atlantic and the Mediterranean, but has apparently not been met with elsewhere in the western Atlantic.

Three species of 'butterfly-fishes' (*Chætodontidæ*), a brilliantly colored family of the tropical seas, have been taken at Woods Hole. One of these, the 'parche' (*Chætodon ocellatus*), is not rare, being observed here nearly every year and also occurring in New Jersey and Rhode Island waters. The 'Portuguese butterfly' (*C. striatus*) is a straggler met with in 1894, one specimen being taken in October; it is not known elsewhere outside the West Indies. In 1897, in August and October, 6 examples of a strikingly beautiful new chætodont (*C. bricei*) were obtained.

Five species of the typical sub-tropical family of snappers (*Lutianidæ*) are now known from Woods Hole as stragglers, two being noticed for the first time in 1897. Besides the red snapper (*Neomænis aya*), the schoolmaster (*N. apodus*) and the mutton-fish (*N. analis*), there were taken last year in September young specimens of the gray or mangrove snapper (*N. griseus*) and the dog snapper (*N. jocu*) The first of these has been recorded from New Jersey, but is not found in any abundance north of Florida; the second has not been previously reported north of the Florida Keys.

One of the most noteworthy captures was a small trigger-fish of the genus *Canthidermis*, taken in 1897; this is referable to Cope's *Balistes asperrimus* from the Isthmus of Panama, the type of which, in the Philadelphia Academy of Natural Sciences, has been compared with the Woods Hole specimen. No other examples are known, unless these prove to be the young of *Balistes sobaco* of Poey, from the West Indies.

In 1895 a porcupine-fish (*Diodon hystrix*) was taken in Buzzards Bay near the station. The only other specimens known to have been found north of Florida were taken on the shores of Maryland many years ago.

The family of marine gars (*Esocidæ*) has three members on the New England coast, one of which (*Athlennes hians*) is represented by a large specimen taken at Woods Hole in 1895. This species normally ranges from the West Indies to Brazil, and is not elsewhere recorded north of Florida.

The 'permit,' or black-finned pompano (*Trachinotus goodei*), described in 1896 from

the West Indies and southern Florida, was first taken at Woods Hole in 1894, and has since been found on several occasions. The species attains a weight of over 25 pounds, but only small specimens (3 inches or less) have up to this time been obtained here.

One species of half-beak (*Hyporhamphus roberti*) is common at Woods Hole, and in the current year another species (*Hemirhamphus brasiliensis*) was found for the first time. The latter is reported from Chesapeake Bay, but from no other localities north of Florida.

In August, 1898, there was taken a small file-fish of the genus *Alutera*, which resembles a fish known from Asiatic waters since pre-Linnæan times and described by Osbeck in 1757 as *Balistes monoceros*. It also has some points of similarity to the Cuban fish described and figured by Parra in 1787 under the vulgar name of 'lija barbuda,' which was subsequently identified by Poey and called by him *Alutera guntheriana;* the latter is regarded by some recent authorities as identical with *A. monoceros*, but the lack of specimens has prevented a settlement of the question. The Woods Hole fish differs in a number of important features from the foregoing, and apparently represents an undescribed species.

Hugh M. Smith.

U. S. Commission of Fish and Fisheries.

NOTES ON INORGANIC CHEMISTRY.

Up to the present time there has been little experimental evidence of the trivalence of the so-called rare earths. They form no volatile compounds in which the density can be determined. The single proof of the correctness of the formulæ Ce_2O_3, La_2O_3, etc., has been the determination of the specific heat of the metals by Hillebrand, which would give the atomic weights of the metals as about 140. This has been generally accepted by chemists, but from time to time certain French chemists, notably Wyrouboff, have questioned the trivalence. This has been largely on crystallographical grounds. Wyrouboff shows that the silicotungstates of cerium, lanthanum and didymium are isomorphous with that of calcium, and argues from this that these metals must be bivalent. It is also stated that these metals in their compounds have certain strong resemblances to the alkaline earths. The whole subject is taken up by W. Muthmann, of Munich, in the *Berichte* and very fully discussed. He finds that many of these supposed resemblances do not exist in reality and that others do not substantiate the inference drawn from them. Particularly he shows that the fact that metals replace one another in isomorphous salts by no means proves them to have the same valence. By this argument a large share of the metals would be made bivalent. Especially in salts of high molecular weight, as in the salts of complex acids, the negative complex is the dominating influence in determining crystallographic form. This important principle is well sustained by Muthmann. To settle the matter of the valence of these metals beyond controversy, he has determined the valence, by the conductivity of solutions of lanthanum nitrate, sulfate and chlorid of different strengths, and the molecular weight of cerium chlorid by the boiling-point method. In every case a trivalent formula is obtained, and the correctness of the usually-given formulæ for compounds of these metals may be considered as finally established.

The work of Professor Jörgensen, of Copenhagen, on the cobalt-ammonia bases is well known. It has continued over many years, following the work of Gibbs and Genth, which was published in the Smithsonian Contributions to Knowledge in 1856. In the last number of the *Zeitschrift für anorganische Chemie*, Jörgensen gives a most

valuable *résumé* of this work, collecting together, from his many articles, the best methods of preparing each compound of the class, and in many cases adding much hitherto unpublished information. The *résumé* will be of the greatest help to all future workers in this interesting field, for much as has been done by Dr. Gibbs, Professor Jörgensen and others, the ground can be said to be hardly more than broken.

A PRACTICALLY new field has been opened in the same number of the *Zeitschrift*, by Professor Sabanejeff, of Moscow, that of structural isomerism in inorganic compounds. While there seems to be no inherent reason why structural isomers, which are so familiar in organic chemistry, should not exist among inorganic compounds, no undoubted cases have hitherto been proved. The two isomeric sodium potassium sulfites $NaKSO_3$ and thiosulfates $NaKS_2O_3$ of Röhrig and of Schwicker are doubtful, and Hantzsch has shown that the two nitramins NH_2NO_2 are rather stereoisomers than structural isomers; indeed, Hantzsch says that it seems probable that structural isomerism is perhaps confined to the compounds of carbon. Sabanejeff has attacked this problem with great success, and his first article deals with salts of ammonium, hydroxylamin and hydrazin. He describes seven pairs and one triplet of structural isomers, three of the fifteen compounds being new and nine never before analyzed. Among the pairs are hydroxylamin hypophosphite, NH_3O,H_3PO_2, and acid ammonium phosphite, $NH_3H_3PO_3$; hydrazin phosphite, $N_2H_4H_3PO_3$, and acid ammonium amidophosphate, $NH_2PO(OH)_2$-NH_3; and the triplet, ammonium oxyamidosulfonate, $NH(OH)SO_3H.NH_3$, hydroxylamin amidosulfonate $NH_2SO_3H.NH_3O$, and hydrazin sulfate, $N_2H_4H_2SO_4$. In all these cases the salts are well characterized and stable. This work is of great importance, as it settles the fact that structural isomerism is a general property and not peculiar to the compounds of carbon.

J. L. H.

CURRENT NOTES ON ANTHROPOLOGY.

CRANIOLOGICAL OPINIONS.

THE subject of craniology in its relation to anthropology is taken up by Dr. R. Lehmann-Nitsche in an article in the *Revista del Museo de la Plata* (Tom. IX., 1898). After some preliminaries, he points out with distinctness the inability of a single physical peculiarity, such as the cranial index, to fix racial lines; and draws a comparison between the two theories most recently propounded, the one by Wilser and the other by Sergi, showing how they are in absolute contradiction.

His conclusion is that 'craniology, as at present studied, is incapable of defining typical or racial characteristics.' Much of this, he argues, is due to a confusion of biological and racial factors of development.

Dr. Marina, in his 'Studii Antropologici' (Torino, 1897), concludes with the affirmation: "The terms 'leptoprosopic' and 'chamæprosopic,' no more than those of 'dolichocephalic' and 'brachycephalic,' are competent for distinguishing the varieties and types of the human skull."

Some may remember that in a work published eight years ago I advanced precisely this opinion about craniology ('Races and Peoples,' pp. 19, 20).

ANCIENT GRAVES IN MAINE.

DR. CHARLES C. WILLOUGHBY, chief assistant in the Peabody Museum, in Vol. I., No. 6, of the 'Archæological Papers' published by the Museum, gives a careful account of his investigations of the prehistoric burial places along the coast of Maine. It is well illustrated, with four plates and fifty drawings in the text.

The graves differed in age. Beads of na-

tive copper were found in one, with fragments of bone. In others the bones had entirely disappeared. There was no pottery, but well-made, polished and chipped stone implements (as arrow-points, knives, celts, gouges and pendants) were abundant. Iron pyrites for 'firestones' and red ochre for paint were quite common.

Both Dr. Willoughby and Professor Putnam (who contributes a prefatory note) express a doubt that these were Algonquian graves. They suggest the Beothucs of Newfoundland as their possible constructors.

GEOGRAPHY AND ANTHROPOLOGY.

This autumn the Geographical Institute of Brussels, a branch of the 'Université Nouvelle,' begins its courses of instruction. It offers a three years' course in geography and expects to grant a diploma.

It is interesting to note the position assigned to anthropology in this course. In the first year it divides with biology one hour a week; in the second and third year it has one hour a week to itself, and in the third year ethnography has also an hour; these out of about fifteen instruction hours weekly. The professor of this course is not named in the preliminary announcement.

This is perhaps as much as can be expected at present; but it seems still remote from the definition of geography given by Dr. Hugh R. Mill some years ago—'the description of the earth in relation to man.'

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

A NATIONAL PHYSICAL LABORATORY FOR GREAT BRITAIN.

The report of the committee appointed by the Treasury to consider the desirability of establishing a national physical laboratory was issued on October 4th. The Treasury minute appointing the committee was dated August 3, 1897, and was as follows:

To consider and report upon the desirability of establishing a national physical laboratory for the testing and verification of instruments for physical investigation; for the construction and preservation of standards of measurement, and for the systematic determination of physical constants and numerical *data* useful for scientific and industrial purposes; and to report whether the work of such an institution, if established, could be associated with any testing or standardizing work already performed wholly or partly at the public cost.

The committee consisted of Lord Rayleigh (chairman), Sir Courtenay Boyle, Sir Andrew Noble, Sir John Wolfe Barry and Messrs. W. C. Roberts-Austen, Robert Chalmers, A. W. Rücker, Alexander Siemens and T. E. Thorpe.

The committee review the existing institutions in Great Britain and state:

After consideration of the evidence the committee have come to the conclusion that an institution should be established for standardizing and verifying instruments, for testing materials, and for the determination of physical constants. Work useful both to science and industry could therein be performed for which no adequate provision is at present made, either in this country or at the Bureau International des Poids et Mesures. Such work could not, or, at all events, in all probability would not, be undertaken by individual workers or by institutions primarily devoted to education. In the opinion of the committee the proposed institution should be established at the national expense on lines similar to, though not at present on the scale of, the Physikalisch-technische Reichsanstalt.

The conclusions of the committee are as follows:

1. That a public institution should be founded for standardizing and verifying instruments, for testing materials, and for the determination of physical constants.

2. That the institution should be established by extending the Kew Observatory in the Old Deer Park, Richmond, and that the scheme should include the improvement of the existing buildings, and the erection of new buildings at some distance from the present observatory.

3. That the Royal Society should be invited to control the proposed institution, and to nominate a governing body, on which commercial interests should be represented, the choice of the members of such body not being confined to Fellows of the Society.

4. That the Permanent Secretary of the Board of Trade should be an *ex-officio* member of the governing body; and that such body should be consulted by the Standards Office and the Electrical Standardizing Department of the Board of Trade upon difficult questions that may arise from time to time or as to proposed modifications or developments.

THE FRANKLIN INSTITUTE.

THE Franklin Institute, Philadelphia, founded in 1824, makes an appeal for an increased endowment. The present endowment is small, and although the membership of nearly 2,000 contributes an annual addition to the income, this is not sufficient to carry on the work. The membership is largely composed of artisans, and the dues ($8 per year) are properly low, so that the benefits of the Institute may reach as many as possible. A fund of $350,000 is needed, of which it is hoped that at least $100,000 may be provided by the present effort.

The Franklin Institute is able to point to the following record of achievements in behalf of science and its applications:

The Institute held its first exhibition of American manufacturers in October, 1824, and subsequently twenty-eight exhibitions. It instituted the movement that culminated in the Centennial Exhibition of 1876. Its International Electrical Exhibition in 1884 contributed the impulse which has resulted in bringing the United States to the leading position in the utilization of electricity. It founded the School of Design for Women. It established the first high school in Philadelphia. It established a uniform system of machine screw threads. It made tests of the strength of materials for the United States government. It investigated the causes of the explosions of steam boilers, at the request of the Treasury Department. It was the pioneer in making and recording systematically meteorological observations, culminating in the establishment of the Weather Bureau. The publication in its journal of abstracts of specifications and claims of United States patents, from 1826 to 1843, now affords the only available reference to this information, the government having failed to publish them prior to 1843. It aided in founding the Pennsylvania Museum and School of Industrial Art, by lending a helping hand and sheltering roof in its infancy. It investigated the various forms of water wheels for giving economical value to water power. The law of Pennsylvania relating to our system of weights and measures was enacted as the result of the report made by the Institute at the request of the Legislature of the State. In response to a request of City Councils, it nominated an expert commission to report on a future water supply for Philadelphia. In response to a request by the Board of Health, it has recently investigated and reported upon the subject of the abatement of the 'Smoke Nuisance' in Philadelphia. Its journal, published continuously since 1826, now in its 146th volume, constitutes an invaluable record of the arts and manufactures, especially as developed in the United States. The Institute keeps constantly in touch with science as applied to the useful arts, by its lectures and the papers read at its meetings, and those of its Chemical, Electrical and Mining and Metallurgical Sections. Its drawing school, established in 1824, devoted to mechanical and architectural drawing, has been maintained uninterruptedly for seventy-five years. Its library is one of the most complete scientific and technical libraries in the world and is open to the public for reference from 10 a. m. to 3 p. m., to members from 9 a. m. to 10 p. m.

GENERAL.

M. HENRI MOISSAN, Sir William Crookes and Professor J. H. Van't Hoff have been elected honorary members of the American Chemical Society.

THE Harveian Oration before the Royal College of Physicians of London, by Sir Dyce Duckworth, was delivered on October 18th. The Bradshaw Lecture will be delivered by Dr. W. M. Ord on Thursday, November 10th, his subject being 'Myxœdema and allied Conditions.' The Goulstonian Lectures will be given next year by Dr. G. R. Murray, of Newcastle, who has taken for his subject the 'Pathology of the Thyroid Gland.' The Lumleian Lectures for next year will be given by Dr. Samuel Gee. The Croonian Lecturer for 1899 is Professor Bradbury, of Cambridge, and for 1900 Dr. F. W. Mott, F. R. S.

PROFESSOR VOLNEY M. SPALDING (botany),

Professor Alexander Ziwet (mathematics), Professor George W. Patterson (physics) and Professor Dean C. Worcester (zoology), of the University of Michigan, have been granted leave of absence for the present academic year.

Professor E. B. Wilson, of Columbia University, has recovered from the serious illness from which he suffered during the summer, but will take advantage of the Sabbatical year allowed by Columbia University to spend next year in travel and research abroad.

Dr. F. Morley has resumed the chair of mathematics in Haverford College after a year's leave of absence. While abroad he was given the D. Sc. by Cambridge University.

Professor Israel C. Russell, of the department of geology of the University of Michigan, spent the three months' summer vacation conducting a geological survey for the United States government over the northern portion of the Cascade Mountains. The greater part of the work was in Washington State and extended from the Northern Pacific Railroad to the Canadian boundary, crossing the mountains several times. Among the places of interest visited was Glacier Peak, the height of which was verified.

Professor James A. Craig, of the University of Michigan, spent the summer vacation in London at work in the British Museum, on the astrological-astronomical tablets of the Kujundjik (Nineveh) collection known as the Illumination of Bêl. This is the most important series of unedited texts in the British Museum and by far the most important in many respects to be found in any of the collections extant. Professor Craig has now completed all the texts of the series, which numbers about 130 tablets. His manuscript is already in the press with Die Hinrichs'sche Buchhandlung, Leipzig.

Dr. W. P. Wilson, Director of the Philadelphia Commercial Museums, has arranged to give a course of lectures at the Museums on commercial geography before the Philadelphia Normal and High School students.

The United States Civil Service Commission announces that on October 25, 1898, examination will be held for the position of assistant, editing, abstracting, proof-reading and indexing, in the Department of Agriculture, at a salary of $1,200 per annum. The scope of this examination may be found in Section 67 of the Manual supplied by the Commission.

The fifth annual exhibition of the department of entomology of the Brooklyn Institute was opened on October 8th at the museum building, and will continue through the month. It includes rare specimens of moths and butterflies, filling some forty-eight cases, most of which are loaned from the collection of the late Mr. Berthold Neumögen. This collection, containing nearly 120,000 specimens made at a cost of $75,000, is deposited in the Brooklyn Museum.

There is a serious epidemic of yellow fever in Louisiana and Mississippi, more than 1,000 cases having occurred. The usual panic accompaning epidemics of yellow fever in the South has followed, and it appears that the patients are not properly cared for. Still the mortality is low, only 69 deaths having been reported.

At the Boston meeting of the American Chemical Society the Secretary reported the membership to be 1,318, an increase of 162 since its annual meeting in December last. Professor Edgar F. Smith was elected a member of the Committee on Papers and Publication, and a committee was appointed to consider an increase in the membership of this Committee, so that it shall include special representatives of each of the important departments of chemistry. It was decided to remove the library to Havemeyer Hall, Columbia University, and Mr. M. T. Bogert was elected Librarian.

The American Ornithologists' Union will hold its sixteenth annual meeting at Washington, D. C., beginning on November 14th. Titles of papers should be forwarded to the Secretary, Mr. John H. Sage, Portland, Conn., not later than November 6th.

A convention of Weather Bureau officials was held at Omaha on October 12th and 13th. A number of interesting papers were presented, including one on the 'West Indian Hurricane Service,' by Professor Willis L. Moore, Chief of the U. S. Weather Bureau.

THE second Huxley lecture given by Professor Rudolf Virchow at the opening of the Charing Cross Hospital, on October 3d, entitled 'Recent Advances in Science and their bearing on Medicine and Surgery,' was of great interest both to men of science and physicians. If space permit it will be republished later in this JOURNAL. Professor Virchow was given a complimentary dinner on October 5th, the chair being occupied by Lord Lister. Speeches were made by Lord Lister and Professor Virchow, as also by Sir W. Broadbent, Surgeon-General Jameson, Sir Samuel Wilkes, Sir William MacCormack, Professor Chiene and Sir William Turner. Professor Virchow was expecting to be present at the ceremonies in connection with the opening of the Thompson-Yates Laboratory at Liverpool on October 8th.

THE following details regarding the life of Professor Virchow, taken from *The British Medical Journal*, may be of interest: Rudolph Ludwig Karl Virchow, to give him his full complement of names, was born on October 13, 1821, at Schivelbein, a small town in Farther Pomerania. He received his early education in the gymnasium of Cöslin, where he was thoroughly grounded in the Latin and Greek languages, and where also he learnt Hebrew so well that he took it up as a voluntary subject at his *Abiturientenexamen*, which he passed in 1839. In the same year he entered the Friedrich Wilhelm Institute, for the training of army surgeons, in Berlin. At this medico-military academy—from which have come at different times many men of the highest distinction, such as Nothnagel, Leyden, Hueppe, Loeffler, Gaertner, Schmidt-Rimpler, Fraentzel and others—Virchow had Hermann von Helmholtz among his fellow students. Among his teachers were Johannes Müller, Schoenlein, Dieffenbach and Casper. The teacher who most influenced him was Müller, who, in Virchow's own words, 'founded no school in the sense of dogmas, for he taught none, but only in the sense of method.' Virchow took his Doctor's degree in 1843, his inaugural thesis bearing the title 'De Rheumate præsertim Cornæ.' Soon after graduation he was appointed Prosector in the Charité Hospital where he laid the foundations of his future fame as a pathologist. In 1848 his name first began *volitare per ora* in consequence of his being sent to investigate a severe epidemic of typhus in Upper Silesia. The report which Virchow presented on that occasion was not only a masterpiece of scientific investigation, but marked him out as a man of the most enlightened philanthropy. What he saw in the course of that inquiry converted him to Radicalism, a political creed which he has ever since professed. He insisted strongly on the necessity of social as well as sanitary reform for the prevention of evils such as came under his notice in Silesia. On his returning to Berlin, while continuing to add new truths to the new science of pathology which he was creating, he was very active as a reformer of society in general and of his own profession in particular. In conjunction with a kindred spirit he founded a journal entitled *Die medicinische Reform*, in which the wrongs and grievances of the profession in Germany were discussed in a remarkably outspoken manner. This periodical ceased to exist on Dr. Virchow being called to occupy the chair of pathology in the University of Würzburg, in 1849. At Würzburg he remained seven years, his fame meanwhile spreading over the whole world, so that when a vacancy in the corresponding chair at Berlin occurred, in 1856, he was appointed to it in the teeth of strong political opposition. It would be out of place here to attempt to give even a summary of his scientific achievements. It is sufficient to recall that his great work, 'Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre,' began to appear in 1855. In that work the far-reaching doctrine *Omnis cellula a cellulâ* was enunciated, and from this 'cell' has come the long and splendid series of its author's later contributions to knowledge. In 1858 appeared Virchow's other great work, 'Die krankhaften Geschwülste.' Reference should also be made to his famous *Archiv*, which a year or two ago celebrated the jubilee of its foundation, and which still stands in the front rank of publications devoted entirely to scientific medicine. A list of his writings would occupy several pages of this JOURNAL. Among Virchow's great works may be counted his famous museum, which, when

he first became professor in Berlin, numbered only some 1,500 specimens. But Virchow is not merely the greatest of living pathologists; he has for half a century been equally prominent in his own country as a politician. He has for many years been the leader of the Opposition in the German Reichsrath, and between thirty and forty years ago he had the honor of being challenged by Prince Bismarck. It is much to Virchow's honor that he had the courage to decline to risk a life so valuable for science and humanity in a foolish duel. Even pathology and politics do not exhaust the intellectual activities of this many-sided man. He is President of the German Geographical Society, in the work of which he takes the keenest interest. He is also justly famous as an anthropologist and archæologist. It may be added that in his writings he shows a feeling for literary form rare in medical authors, and especially rare in German professors. His lucidity of style and the logical order in which he unfolds his thoughts make his works a pleasure to read.

Dr. Woodward, Health Officer of the District of Columbia, has submitted to the Commissioners his estimates for appropriation, the sum being placed at $160,540. The estimates include $5,000 for the establishment and maintenance of a bacteriological laboratory.

Good work is being done by the Paris municipal bacteriological laboratory, says the New York *Medical Record*. This laboratory for the diagnosis of contagious affections was created by the Municipal Council in 1895, and is open to the public every day in the year from eight o'clock in the morning until eight in the evening, including Sundays and holidays; moreover, the necessary articles are given to doctors who ask for them for the bacteriological diagnosis of diphtheria, tuberculosis and contagious affections of which the germs are known. The results of the analyses are sent directly to the doctors, at longest twenty-four hours after reception of the pathogenic products at the laboratory. These results can be sent by telegraph if desired and at the expense of the doctor, but the examination and diagnosis are absolutely gratis. The laboratory received in August, 1898, forty-eight products suspected to be tuberculous, in which the bacillus of Koch was discovered sixteen times.

UNIVERSITY AND EDUCATIONAL NEWS.

The Board of Education of New York City has presented to the Board of Estimate and Apportionment a request for over $12,000,000 for current expenses and about $10,000,000 for new buildings for the year 1899. The estimates for current expenses are $3,000,000 more than the appropriation for the present year, the additional sum being intended chiefly for the increase of salaries.

The will of the late John D. W. Joy, of Boston, gives $30,000 to Tufts College, the bequest to take effect on the death of his widow.

A new class of honorary fellowships has been created this year at Cornell University. Those holding the Ph.D. degree from any institution may obtain these fellowships, which carry no emolument, but allow free tuition, the use of the library, etc.

Dr. Simon Flexner, associate professor of pathology at the Johns Hopkins University, has been appointed professor of pathological anatomy.

The following promotions and new appointments have been made at the Massachusetts Institute of Technology: Henry P. Talbot, to be professor of analytical chemistry; H. O. Hoffman, professor of mining and metallurgy; D. P. Bartlett, associate professor of mathematics; R. R. Lawrence, instructor in physics; and as assistants: J. C. Coffin, H. W. Smith and M. D. Thompson, in physics; and G. M. Holman, in biology.

The following instructors have been appointed in the University of Michigan: Lawrence Bigelow, in chemistry; James Pollock, Hamilton Timberlake and Julia W. Snow, in botany; Augustus Trowbridge, in physics; W. H. Butts and A. W. Whiting, in mathematics, and Archibald Campbell, in organic chemistry.

Dr. Martin B. Stubbs, of Haverford College and Johns Hopkins University, has been appointed assistant in chemistry and physics in Haverford College.

The British Education Department has issued

the reports which have been received this year from the twelve colleges which participated during the year ended March 31st in the annual grant, now amounting to £25,000, made by Parliament for 'University Colleges in Great Britain,' and the three colleges in Wales, which receive from the Treasury a grant of £4,000 each. The twelve colleges are: Birmingham, Mason College; Bristol, University College; Dundee, University College; Leeds, Yorkshire College; Liverpool, University College; London, Bedford College, King's College, University College; Manchester, Owens College; Newcastle-upon-Tyne, Durham Science College; Nottingham, University College, and Sheffield, University College. The Welsh Colleges are: Aberystwyth, University College of Wales; Bangor, University College of North Wales; Cardiff, University College of South Wales and Monmouthshire. Major P. G. Craigie's annual report to the Board of Agriculture on the distribution of grants for agricultural education and research in 1897–98 has also been issued as a Parliamentary paper. The total amount distributed during the financial year to the fifteen institutions receiving assistance was £7,200, as compared with £7,000 in the previous year.

DISCUSSION AND CORRESPONDENCE.

TROCHOSPHÆRA AGAIN.

IN SCIENCE of December 25, 1896, Dr. Kofoid, of the Illinois Fresh-water Biological Station, records the occurrence, during the preceding summer, of *Trochosphæra solstitialis* Thorpe in the Illinois River. The discovery in America of this remarkable Rotifer, previously known only from the antipodes, is of great interest. Dr. Kofoid raises the question whether its presence in Illinois is due to recent importation, or whether *Trochosphæra* is to be considered a normal member of our fauna, taking a place with many other Rotifera as a cosmopolitan form. Its rediscovery at a station distant from that recorded by Kofoid is perhaps worthy of mention in the columns of SCIENCE. *Trochosphæra solstitialis* was found in the work of the Biological Survey carried on during the past summer at Put-in-Bay Id., Lake Erie, by the U. S. Fish Commission. It occurred very sparingly in a swamp near the U. S. Fish Hatchery, Put-in-Bay, for a few days in August, 1898. This swamp has a dense bottom growth of *Ceratophyllum*, while the surface is completely mantled with *Lemna*, *Spirodela* and *Wolffia*. It is connected with Lake Erie by a streamlet about forty feet in length, the direction of the current through which depends upon the level of the lake. When the lake is high, water flows into the swamp, and at such times the ordinary plankton Rotifera of the lake are found in the swamp. When the lake is low the swamp water passes outward into the lake. *Trochosphæra* was found at a low-water period, along with *Notops clavulatus* and some other Rotifers which, though rare, are known to be widely distributed. As this swamp has such intimate connection with the lake, it would not be surprising to find *Trochosphæra* in swampy parts of Lake Erie itself.

The discovery of *Trochosphæra* at two such widely separated stations in the United States certainly tends, so far as it goes, to indicate that the animal is to be considered a normal member of the American fauna. Workers on Rotatoria are few in America, and it may be that more extended observations would show *Trochosphæra* to be widely distributed, even though somewhat rare.

Unfortunately, but few individuals were obtained, so that it is not possible to furnish specimens to those desirous of examining this remarkable animal.

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THE OCCURRENCE IN GREAT ABUNDANCE OF INSECTS ORDINARILY MERELY COMMON.

A NOTE in one of the New York papers a day or so ago reporting that a strange butterfly—in all probability *Anosia plexippus*, judging from the description of the color—was present in extraordinary abundance at Topeka, Kansas, on the 6th inst., preventing work out of doors and gathering on the rails of a branch of the Union Pacific Railroad in such numbers as to stop a train by their bodies greasing the rails, calls to mind a similar large swarm of this species seen by the author near Unadilla, Nebraska, in 1885. The air was full of the in-

sects, which were flying lazily southward, paying no attention to the flowers in their way. They were not quite as numerous, however, as the Topeka report makes them out to have been. Large swarms of this species are not infrequent, being noticed from time to time.

The report also calls to mind two other instances that come under this head. One is a report of a large number of centipedes seen in Nebraska all crawling soutward (?) and noted by the author in SCIENCE some years ago. The other was the occurrence at Lincoln, Nebraska, in 1889 or 1890, of a great swarm of *Hydrophillus* (probably *triangularis*) attracted apparently by the electric lights. They were so numerous that the sound produced by their striking the electric cars resembled the rattle of large hail stones. They came in at the open windows of the cars, greatly annoying the passengers. Along the sidewalk of O Street their mashed bodies were very numerous. Possibly a bushel or more could have been swept up in the distance of a block. The occurrence of the insect in such large numbers is the more remarkable since in the vicinity of Lincoln it had not formerly been noted as a very common species, ponds and other suitable breeding places not being abundant. Yet the fact that the electric light appeared to form a factor in the concentrated abundance of the insect seems to indicate that the gathering was probably from the country round about, though it does not preclude the possibility of a migrating swarm, due possibly to the drying-up of their natural habitats.

F. C. KENYON.

WASHINGTON, D. C., October 8, 1898.

SCIENTIFIC LITERATURE.

SOME RECENT LITERATURE ON CHILD-STUDY.

THERE are probably few terms in popular use which are more variously understood than Child-Study. In the minds of some it revives a harrowing scene wherein parents and teachers are observed plying trivial or abstruse questions to their children, or experimenting with them in other ways, in the endeavor to obtain data requested in syllabi and blanks which are being scattered broadcast over the land, having already, as one eminent person is afraid, found their way into most homes and school-rooms of the country. When these data are obtained they are hurried off to the designers of the syllabi, who tabulate them, presenting the outcome in numerical results which are supposed to constitute the propositions of a presumptive science of Child-Study. To other minds this term denotes a significant movement which has for its purpose the investigation of psychical phenomena occurring in the development of human beings, this work being conceived of as different from the analysis and description of adult consciousness. Those who regard Child-Study from this point of view see that while some of the investigations that are being made, possibly the majority of them, are valueless from a scientific standpoint, yet the heart of the thing is full of vitality and is well able to produce increasing abundance of life in the whole structure.

To those who have 'syllabi' and 'Child-Study' so strongly associated that they cannot be dissevered, this movement will be looked upon as a fad of only temporary interest and of little or no importance. Professor Baldwin, for instance, seems to estimate Child-Study in this way;* for he certainly cannot have in mind the broader reaches of the subject as concerned with the study of human ontogeny, since he would scarcely regard his own numerous contributions thereto, nor would anyone else, as of a faddish, transitory character. It seems likely that others have connected the term simply with the least important aspects, with the froth or eddyings, one might say, of the study of developmental psychology Doubtless its origin and use has led to this confusion, since it has been employed principally by those who have suddenly become infatuated with the study of children, but who have brought to the undertaking meager attainments, and scarcely any first-rate qualifications for rightly conducting the work. In this way much is being offered as contributions to science which in its elaboration has not conformed to the rules of scientific procedure. But to some investigators at least this is not an occasion for discouragement, but rather one for rejoicing and congratulation, since all science has been conceived and nour-

* See *Psychological Review*, March, '98, p. 219.

ished in its infancy in this apparently unscientific manner. When there is vast enthusiasm in new phenomena on the part of the populace large amounts of data regarding them may be obtained where otherwise it would be extremely difficult to secure them; and while there is danger of error creeping into the conclusions as a result of materials being amassed whose antecedents and accompaniments have not been properly ascertained in the recording, still this error cannot long abide the scrutiny of scientific and practical people, and it must consequently be at best short-lived.

One of the peculiarities and at the same time one of the chief difficulties characteristic o this subject of Child-Study is the diversified methods which are being pursued in obtaining data. Mr. Sully, in his Children's Ways,* has made use of a mode of studying children which will doubtless become increasingly popular. He evidently carries about him a note-book into which go many things that he hears and sees when he is in the company of childhood. Then at his leisure he classifies what he has noted, and gives the result to the reader without making any serious effort at explanation or interpretation. His purpose in this book seems to be simply to draw the attention of people to phenomena in child life which, while oppressively common one might almost say, are yet very little heeded by the average parent or teacher; for the reason, doubtless, that the things with which we are constantly in contact are apt to acquire an indifferent interest for us. We accept them as matters of course, and are then rendered incapable of seeing the great truths embodied in them. This in itself justifies such a book as Mr. Sully's—that it incites thought regarding some of the most frequent exhibitions of child-life.

The 'Ways of Children' is adapted principally for popular reading, and Mr. Sully probably had no intention of contributing very extensively to the science of human development by the things which he has written therein. And yet the scientist will find here data well classified which will be of value in elaborating certain principles of ontogenesis. The materials have the exceptional quality of being for the most part rudely concrete; they are the verbatim utterances of real children and vivid descriptions of their doings. One may get some idea of the range of the author's observations by glancing over the titles of his chapters: The Realm of Fancy; The Enchantment of Play; Attacking our Language; The Serious Searcher; First Thoughts: (*a*) The Natural World, (*b*) Self and other Mysteries; The Battle with Fears: Good and Bad in the Making; Rebel and Subject; At the Gate of the Temple; First Pencillings.

Some may, upon reading this book, feel that it deals, after all, with quite trivial affairs. For one thing, Mr. Sully does not produce tables and curves, the summaries of studies upon multitudes of children; and many in these days seem to think that the study of two or three individuals is of no great account for either practice or theory. We must have experiments by the thousands and laws in percentages. But it is interesting to speculate upon the value to science of discovering that nine hundred and seventy-five children perform in a certain way, while nine hundred and fifty of the same age and under the same conditions act differently. In the face of results like these the experimenter concludes that rather more act in a given way than otherwise; but when this conclusion is to be made the basis for a principle or system of training its work is exceedingly doubtful, to say the least. Is it not of greater value to have the product of careful daily observations upon a few children than to be continually working with such large figures? Have we not in child-study fallen victims to the general tendency to overestimate the importance of magnitude—of great numbers and large sizes?

When Mr. Sully attempts to assign motives for the activities he sees in children he is apt to raise doubts in one's mind, as perhaps might be expected. For instance, witness what he gives as his opinion respecting the reason why children love to play at rolling hoop*: "Is not the interest here due to the circumstance that the child controls a thing which in the

*Sully: Children's Ways, Being Selections from the Author's 'Studies of Childhood,' with some Additional Matter. D. Appleton & Co., N. Y.

*Page 24.

freedom of its movements suggests that it has a will of its own? This seems borne out by the following story: A little girl of five once stopped trundling her hoop and said to her mother she thought that her hoop must be alive, because 'it is so sensible; it goes where I want it to.' Perhaps the same may be said of other toys, as the kite and the sailing boat." To the writer it seems that the interest lies mainly in the great wealth of motor adjustments which this game occasions, together with the delight of accomplishing a difficult task; and if the child has any conception of will in the object it at least never rises up into explicit consciousness, even though he employ such terms as 'sensible' in describing its activities. This difference of opinion emphasizes the necessity of employing more exact methods in discovering the motive of much of the evolving mental life of the child.

All students of child-development would feel grateful to Mr. Sully if he had endeavored to find some unifying principle governing the behavior of the child mind at different stages in its progress toward maturity. It may be that there is no such unity of cause underlying the psychical activities of children, but if there is we are sorely in need of it to furnish a guide for the elaboration of an educational scheme. Our gravest affliction now seems to be that our teaching is based upon the doctrine that there is great and essential diversity in mental action, and this leads us in teaching to feel that we must have manifold methods required by the different operations of the mind and various branches of study to train different faculties. It appears very likely that there is more homogeneity in the mental activities of the child than we have been wont to think, and it would be of incalculable benefit to all who train children if they could see the underlying principles of psychical ontogenesis. It would save them from that distraction which seems everywhere apparent in those who have been studying psychology in the old way and learning about the manifold operations which seem to be more or less unrelated to one another. Mr. Sully's book leaves one with the feeling of disperseness; one is a little confused by the heterogeneity of things—the want of any unity of principle. And this feeling lends emphasis to a qustion which of itself would keep popping into the mind of the reader. Are the peculiar sayings and performances of children set down in the book due to minds little stocked with knowledge reacting upon a complex environment, or are the children living over again in some measure the ancestral record? The author does not attempt an answer; and possibly it is well that he does not here, for he might fail of his purpose of enlisting the interest of the lay reader. But it is hoped that he will address himself some time to these problems, for his psychological training should make his discussion of them of value to all students of the evolution of mind in the individual.

Mr. Taylor, in his The Study of the Child,* has produced a very different sort of book from Mr. Sully's. It is evident that he had a different purpose in mind—namely, to instruct young people regarding the proper methods of dealing with children as indicated by the results of modern scientific research. He has an eminently practical aim in view, and in estimating the worth of his work this must be kept constantly in mind. The scientific student would be apt to complain considerably of the method pursued unless he held before himself all the time its purpose, which is not to advance a science but to apply it in the most concrete way possible. It seems from the tone of the writing that the contents of the book were originally given as lectures to Mr. Taylor's students in the Normal School at Emporia, Kansas, and one is impressed that they must have been of interest and value to these teachers who have probably come to this subject with little previous acquaintance, and who have immediate practical problems in the school-room to solve.

In the main Mr. Taylor writes clearly and intelligibly for the readers he has in mind, which is not a simple task by any means; and he makes his discussion concrete by producing an abundance of apt illnstrations which have fallen within his own experience. But the writer wonders why he felt it necessary to cling so closely to the terminology and methods of classification of the older psychology. He

*Taylor: 'The Study of the Child.' New York, D. Appleton & Co.

starts off discussing the various senses, then consciousness and apperception, then attention, followed by symbolism, language, muscular or motor control, feelings, will and its functions, perception, memory, imagination, conception, judgment, reasoning, etc. The disquisition upon the senses is principally hygienic, with some consideration of the effects upon the mind of their imperfect functioning, and the importance and method of training them. One feels in this part of the book that Mr. Taylor has the child always in mind, but when he reads the chapters upon the intellect and will he is distressed to find the treatment following almost precisely the methods of adult analytic psychology. Why are these things not viewed in the light of their development, their evolution, their genesis, showing how all the various operations, if they are really different, have come to be so in the child's mind? Perhaps the author felt that for young teachers he has proceeded in the most practical way to discuss the mental operations. But if he does, the writer must certainly differ with him; for it seems that it would be of far greater value, considered alike from the point of view of clearness of appreciation and concreteness to teachers of any age or degree of experience, to see how the intellect grows in a child than to examine what it is when full formed, except as the latter aids and complements the former. A teacher has to foster and direct mind growth, and she is not concerned at all with the fully grown thing, only as it enables her to comprehend the nature of the evolving entity more truly and completely.

When one keeps in mind the purpose of the book he can understand why reference has not been made more extensively to acknowledged authorities, and, also, why the style is so largely hortatory, even possibly dogmatic. It is addressed to persons who are not interested primarily in scientific method and accuracy, but who readily accept doctrines upon authority and who need to be exhorted to observe them in their own conduct. A criticism, though, should here be offered, which is applicable to much of modern writing upon Child-Study and allied subjects; propositions are ofttimes of too universal and sweeping a character when the author cannot possibly have observed their applications in but a few instances. As an illustration of this tendency we may quote a passage which, by the way, discusses a very important matter: "Many a babe's mouth is sorely blistered by a hot gargle that the nurse, accustomed to drink boiling-hot tea three times a day, declares to be 'just warm, now dearie.' *Hot plasters and poultices are clapped on the little innocents without intelligence or mercy for the same reasons, and incalculable injury is thus done to a multitude of children.*" (The italics are added.)

Any book dealing with the practical applications of science is much more liable to arouse misgivings here and there than one which simply presents the results of scientific experiment. To fit a principle to concrete conditions is a task of more serious mien than to simply work out the principle, for in the first instance many more factors have to be thought of together and adjusted to one another. Mr. Taylor's book is to be warmly commended as illustrating and promoting a movement in the training of teachers in the normal schools which promises to be most fruitful in the near future. It is to be hoped that he will find time to give us a book on the *growth* of mind in school children, bringing to the work the results of modern experimental science, as he has done in the present volume in the treatment of the senses and other important subjects.

It seems to the writer that one of the most profitable lines of investigation, alike for a science of developmental psychology and for education, runs out in the direction of psychobiology; or, perhaps more definitely, psychophysiology. It will doubtless be generally appreciated that we must derive from physiological studies the hygienic conditions in conformity to which educational processes must occur. It seems, too, as if we were already able to say that the development of the brain and mental ontogenesis are closely correlated; and if this be true it should, in a very important way, contribute to a determination of the materials and methods of instruction at various stages in the child's education. The data regarding these matters can be supplied perhaps better by physicians than by any one

else; and The Development of the Child* by Dr. Oppenheim will be gladly welcomed not alone for its own worth, but also as practically initiating a movement which should rapidly increase in breadth and momentum. Dr. Oppenheim is evidently a physician who has given attention not only to matters physical, but in an important manner to things spiritual. His practice being largely in a children's hospital, he has had unusual opportunities for making observations upon the topics which he discusses in his book. His chapter upon Facts in the Comparative Development of the Child is exceedingly valuable, since it strongly emphasizes a thought which is slowly getting established in people's minds—that the child is in many essential particulars different from the adult, and that growth consists, in a measure at any rate, in a series of transformations or metamorphoses which if completed finally culminate in a fully formed man or woman. While the author has comparatively little to say respecting changes which are known to occur in brain growth, yet it is reasonable to infer that this organ, like the others of the body, is subject to metamorphic processes in its progress toward maturity. This chapter illustrates a sort of investigation which it is hoped will receive the attention of scientists more fully in the future—the sequence in the ontogeny of the brain. It is encouraging to observe that physiologists like Wesley Mills are realizing the importance of such researches and are already making some valuable contributions thereto.

The chapter upon the Comparative Importance of Heredity and Environment is especially valuable alike for science and for education. The key-note of the chapter seems to be that the particular line of mental development occurring in the individual is determined more largely by the factor of environment than by anything else. The child, doubtless, brings into life a predisposition in certain directions due to heredity, but unless the elements in the environment favor the nutrition of special embryonic powers these will soon atrophy. Heredity of mental attributes is not so absolute and universal a thing as we have been thinking, says the author; and the reader, even though he has formed an opinion beforehand, will, when he completes the chapter, be inclined to agree to the proposition, in a measure at least. Abundant facts are adduced to show that adequate nutrition is the great determining principle in the development alike of body and brain. The importance of this for education can scarcely be overestimated. Aside from its value for mental hygiene it shows that that element in personality which receives the best nourishment from the environment will be apt to become predominant—an important principle in determining educational values.

But when the reader reaches the discussion of The Place of the Primary School in the Development of the Child he should be prepared for a very pessimistic view of the present situation in the world. It is really oppressive to find that practically everything that is is wrong. The primary school as it exists has nothing to commend it; it violates nearly all, if not all, the principles of normal growth in childhood, because it curtails freedom, spontaneity, and enforces concentration and coordination of bodily and mental powers before nature is ready for such things. One certainly cannot but endorse most heartily the contention of the author for greater freedom to be granted the child in all his school work. But it is hard to believe that everything we have been doing is bad. It is evident that Dr. Oppenheim has not in this chapter written with the same scientific care and caution that he has elsewhere. If he is right, as he will be interpreted by those who read him, the only recourse is in a return to nature wherein the order, the system, the method of education which has grown up in the development of the race will be obliterated, and we shall be back again to an orderless and systemless condition, a kind of neo-Rousseauism. But has not order and method in education been evolved as an essential element of progress in the race? And while undoubtedly formalism has been overemphasized, yet is there not as great danger in lapsing back too far in the other direction?

The same criticism may be made of Dr. Oppenheim's writing here that has been made elsewhere in this article—the hyperbole seems to be too much in evidence. An extract will

*Oppenheim: The Development of the Child. New York, D. Appleton & Co.

illustrate: "The ordinary exercises in drawing are, beyond doubt, *useless* and *harmful*. In its best aspect it is *merely muscle-exercise*, but even as such it is, partly from its cramped and spasmodic position and movements, decidedly deficient. In almost all cases it is the *crudest sort* of *caricature* that *represents* and *portrays nothing*. *It leads to no good*, and it *develops no ability*, but, on the contrary, *elevates wrong and vicious presentments* into undue prominence. *When it is 'directed' it is, if anything, worse;* for then it receives the badge of authoritative affirmation. Unless it is the 'graphic record of of a perceived fact' it is *worse than valueless.*" (The writer has italicised.)

It is certainly a most excellent and needful thing to emphasize freedom and spontaneity in the early years of school work; but the practical question is constantly forcing itself upon educators: When shall we require coordination? How early shall all the powers of the child be concentrated upon a given task? If the author would elaborate his treatise on the primary school, going into greater detail, and base all his conclusions upon clearly evident scientific facts, it would be of incalculable benefit to education. But if matters are left in the form in which they are in this chapter it is to be feared that more distraction and discouragement than anything else will be the result.

It is cause for regret that the author is so hopeless about education as it is at present conducted. And it is not so much what he says explicity as the feeling which his words inspire. It seems as if every teacher was to be blamed for some grave error. The reading of the chapter makes one feel that Dr. Oppenheim believes in the fall of man, instead of in his constant ascendency from lower to higher things. When one gets this latter point of view, he is apt to be more sympathetic toward the failure of the race to realize in practice the highest present ideals in education or in other matters. He sees that we are eternally progressing, and when he criticises his words do not have such a sting; they do not arouse so much antagonism within one as they are otherwise liable to do.

The chapters upon The Child's Development as a Factor in Producing the Genius or the Defective and the Child as a Witness in Suits at Law are both interesting and important for education. In the first is pointed out clearly the danger of extraordinary development in some narrow channel which may produce a genius, but which is liable to bring forth an unbalanced, defective personality. In the second chapter the inability of the child to observe critically and report truthfully concerning the things and phenomena which he witnesses is convincingly discussed. The absurdity of accepting the testimony of the young child in important suits at law is a matter which has escaped the attention of people too fully in the past. The chapter upon The Place of Religion in the Development of the Child seems, for the most part, to be thoroughly reasonable and of practical value as showing how fruitless, not to say vicious, much of our religious teaching is; although it appears to the writer that the author here departs in one respect from the primary principle which he has been emphasizing throughout the book—namely, that in the training of the child we are at all times to accommodate our instruction to his stage of development and not try to force him up into the atmosphere of the adult by too rapid degrees. But Dr. Oppenheim contends that it would be better to teach the child ethics and a rational (rational to the adult, that is) notion of religion at the outset, rather than the mythological perversions which he is apt to acquire as a result of present methods. But is not an ethical view of the world the product of the highest forms of civilization? and, hence, is it not preceded in ontogenesis, as it was in phylogenesis, by a mythopeic conception of the universe? Is it not necessary, then, that the child should pass through a stage of nature-worship and animism before he can be introduced to the relatively abstruse and unintelligible propositions of Dr. Oppenheim's religion and ethics? It seems altogether likely that the only way to attain the higher reaches in this, as in other matters, is by way of the lower strata.

On the whole, this book will be of the greatest worth to education in and out of school, and it is to be hoped that it is but the forerunner of others of the same general character, presenting in comprehensible manner the physician's knowledge of the laws governing the

growth of children, and, founded thereupon, his views of the proper materials and methods of school and home instruction.

There are some intelligent people who conscientiously question the value to teachers and parents of child-study in the mass; but there is probably no one who doubts the supreme value to the instructor of any knowledge which will confer upon him a better understanding of the individual child. It is probably true that, all things being viewed together, the most practical phases of this work relate to the study of individuality, since the parent or teacher is especially concerned with the proper training of each child under her care rather than with the elaboration of a science of any kind. Consequently, a book which would in a concrete, scientific way instruct tutors in the difficult art of deciphering the essential characteristics of individual children would be exceptionally helpful in teaching. Dr. Warner's The Study of Children accomplishes this in an excellent manner, so far as what might perhaps be styled the hygiene of individuals is concerned. It is devoted almost wholly to a delineation of the modes in which defective or depleted cerebral conditions manifest themselves through bodily expressions. Of course, this does not include all of what the teacher and parent ought to know of individual children; but it certainly deals with the most important factor. One would not go far astray in saying that if an instructor could determine when his children were not in such a condition of health and vigor as to profit best by his teaching, and if he could then apply healing and restorative agencies—if an instructor could do this he would satisfactorily fulfill the most important part of his mission. The Study of Children is admirably adapted to give one the power to detect cerebral incapacities in individual children and to suggest in some measure how these may be remedied.

After an introductory chapter and one treating of the body of the child, particular attention being given herein to defects of vision, hearing and breathing, the book proceeds with a description of the architecture and function of the elements of the nervous system, leading up to a science of bodily expression wherein is pointed out, in the first place, the connection between abnormal fashioning of head and features and defective brain construction, causing some sort of deficiency or estrangement in mental action. It is possible that the author attaches too great importance to the value of physiognomy, especially as it would be employed in the hands of an unskilled person; but he is on thoroughly scientific and therefore safe ground when he shows in detail how given motor activities denote correlated cerebral processes as these relate to healthful or diseased neural conditions. The chapters upon Observing the Child; What to Look at and What to Look for; Principles of the Methods of Observing and Describing Children; Points for Observation, Indicating Faults in Body or Brain Action or a Status Below the Normal; Examination of Mental Ability and the Faults that may be Observed; and Some General Conditions in Children Described, are of the greatest worth, because of the admirably concrete way in which the methods of reading expression are delineated.

It is not too much to say that any parent or teacher, upon a careful reading of this book, will be able to deal more wisely with the children intrusted to his care; for he will learn to interpret certain outward expressions as indicative of inner depletion or defect; and he will then not make the mistake, which we know is so often committed, of trying to correct misdeeds by dealing with them as though they were due to perversions of the will instead of being the legitimate issue of disturbing physiological causes. To the writer there is no department of this activity in the study of children which seems of more importance than this which we are now considering; for the reason that education is charged with the responsibility of elevating every individual to the highest possible point of usefulness to himself, and so to society, and this may be accomplished in the case of defectives only when we can apprehend the obstacles to their progress and remove them. And then, even in normal child life, there are so many activities that really at times appear abnormal to the unpracticed eye because of the blighting effects of neural fatigue. In view of these things, then, Dr. Warner's book cannot be too

highly commended to all those who are in immediate contact with childhood in the function of director of any sort.

M. V. O'SHEA.

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Biomechanik, erschlossen aus dem Principe der Organogenese. ERNST MEHNERT. Jena, G. Fischer. 1898. Pp. 177. Mk. 5.

The work before us has two purposes: first, to set forth additional evidence for the 'Principe der Organogenese,' already enunciated in the author's work on 'Kainogenesis als Ausdruck differenter phylogenetischer Energieen,' 1897; and, secondly, to apply this principle to organic evolution. As one can imagine from the ground covered, the work is one of those more or less interesting webs of speculation which even some of the trained German naturalists are fond of spinning at great length.

The principle of organogenesis is thus stated by the author: The rapidity of the ontogenetic process of unfolding of an organ is proportional to the height of phylogenetic development which it has attained at the time. It uniformly increases with the elevation above, and uniformly diminishes with the relinquishment of, a once attained height of development. The meaning of this principle may be made clearer by a few examples. According to the law of recapitulation of phylogeny in ontogeny we should expect a phylogenetically older organ to appear in ontogeny before a phylogenetically younger one. Thus, the great blood vessels of the vertebrate body are doubtless phylogenetically older than the heart and we should expect them to arise before it. But, on the contrary, the heart, because it has attained a higher development than the blood vessels, unfolds in ontogeny first. Its formation has been accelerated. On the other hand, the pineal eye, which is probably derived from that of Tunicates and is, consequently, older than, or at least as old, as the paired eyes, arises in ontogeny later than the paired eyes. Its unfolding has become retarded since the organ has become degenerate. The author, whose view is pretty well limited to vertebrates, tabulates some 33 cases of similar acceleration of physiologically important organs and retardation of physiologically degenerating organs.

This principle of ontogenesis, while not entirely original with the author, is elaborated by him more than it has been heretofore, and especial attention is directed to the fact that the action of this principle nullifies many inferences concerning ancestral conditions drawn from the time of appearing, or the relative size at a given age, of particular organs. Thus it has been argued from the fact that children at birth have proportionately larger brains than adults that the relative size of the brain is diminishing in the human race. According to Mehnert's principle, however, the relatively early attainment of a great size by the human brain indicates that it is a phylogenetically progressing organ, which is certainly a more reasonable as well as a more agreeable conclusion.

Starting from this principle Mehnert now attempts to explain phylogenesis thereby. Here he takes the position of a Neo-Lamarckian in respect to the inheritance of acquired characters, while he accepts Weismann's general conception of preformation in the germ by means of determinants. Individual development proceeds under the influence of two factors. One of them consists of inherited qualities whose development is the 'unfolding of phylogenetic energies;' with this has become associated the second factor, the contribution of those cells which have been added under the special influence of the functional activity of the individual; this is the epigenetic factor. The difficulty of seeing how the acquired characters—the epigenetic factor—are inherited is surmounted in this way: Inheritance is not due merely to a certain chemical constitution of the germ plasm, but also to its physical condition. The molecules of the germ exert a formative influence over each other, much as a bar magnet does over the magnetic field. Now, the quality of this influence is modifiable by the surrounding soma, much as a piece of iron in a modern warship is affected by the distribution and varying conditions of all surrounding masses of the metal. This (chiefly physical) effect of soma upon germ may determine certain qualities in the unfolding of the germ.

And here is where the principle of organogenesis comes in. When an organ is much

used and becomes larger an effect is exerted on the germ such that the organ tends to develop to a larger size in the next generation, and this peculiarity will in later generations be developed earlier and earlier in embryonic life, becoming at the same time more stably heritable.

The work is full of interesting facts, is written in a fairly readable style and is accompanied by an extensive 'Litteraturverzeichniss' of over 11 pages. While one may question the validity of the theory and find the explanation of inheritance of acquired characters vague and unsatisfactory, still we can hardly regard such an attempt as this to draw up a new and complete theory of evolution as entirely in vain.

CHAS. B. DAVENPORT.

SCIENTIFIC JOURNALS.

American Chemical Journal, October: 'On Some Double Halides of Mercury,' by J. N. Swan. 'The Double Halides of Tin with Aniline and the Toluidines,' by R. L. Slagle. 'On Double Halides of Zinc with Aniline and the Toluidines,' by D. Base. These three papers contain the results of work carried on in the Johns Hopkins University, in the general line which has been under investigation there for a number of years. The field has been thoroughly worked over, and, as a result, many of the compounds described in the literature have been shown to be impure substances or mixtures. 'Sulphonation of the Paraffins,' by R. A. Worstall. The author has found that the sulphonic acid of these hydrocarbons can be easily formed, and he has prepared a number of these acids and their salts. 'The Formation of Hydrazides by the Action of Phenylhydrazine upon Organic Acids in the Cold,' by V. L. Leighton. 'Aliphatic Sulphonic Acids, Ethylenesulphonic Acid,' by E. P. Kohler. The recently discovered gases—'krypton, metargon, neon and coronium'—and 'fermentation without cells' are discussed in the Notes at the end of this number.

J. E. G.

SOCIETIES AND ACADEMIES.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, OCTOBER 4, 1898.

AT the opening meeting of the conference general statements concerning the opportunities for advanced geological work in the vicinity of Cambridge were made by the several instructors and two papers were presented.

Dr. J. E. Wolff spoke on 'The Relation of the Granite to the Ore Deposits at Franklin Furnace, New Jersey.' The problem discussed was the relative age of the zinc ores and the granite. According to one theory the ore, granite, limestone and associated secondary minerals are all contemporaneous. While by the other the ore dates from the time the granite was intruded. Dr. Wolff recently observed the contacts between several dikes of granite and the ore body, at the nine hundred and fifty-foot level, Parker Shaft, which were in some cases parallel and in others transverse to the parallel-banded structure of the ore. The granite, in places, showed a finer grain at the contact, a contact zone of garnet and indurated ore, tending to show the intrusion of the granite into the pre-existing ore body.

Dr. R. A. Daly introduced a future illustrated paper on the Volga River, with a sketch of the Physiography of Russia. In travelling across the great basin of Russia one may find evidence of three well defined periods of denudation. The first resulted in the peneplain upon the crystalline foundation which underlies, everywhere and at no great distance from the surface, the Palæozoic and later sediments; the second culminated in Triassic time, and the third is still in progress. The last is marked by a maturely developed peneplain of constant altitude, and remarkable continuity.

J. M. BOUTWELL,
Recording Secretary pro tempore.

NEW BOOKS.

A Text-book of Mineralogy. EDWARD SALISBURY DANA. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1898. New Edition. Pp. vii + 593. $4.00.

Radiation. H. H. FRANCIS HYNDMAN and SILVANUS P. THOMPSON. London, Swan & Sonnenschein; New York, The Macmillan Company. 1898. Pp. xviii + 307.

North America. FRANK G. CARPENTER. New York, The American Book Company. 1898. Pp. 352.